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MANUAL

OF

CONCHOLOGY;

STRUCTURAL AND SYSTEMATIC.

WITH ILLUSTRATIONS OF THE SPECIES.

BY GEORGE W. TRYON, JR.

CONTINUATION BY

HENRY A. PILSBRY,

CONSERVATOR OF THE CONCHOLOGICAL SECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

Vol. XVII.

SCAPHOPODA.

BY

H. A. PILSBRY and B. SHARP.

APLACOPHORA.

INDEX TO GENERA AND SUBGENERA, VOLUMES II to XVII.

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To Reader:

This volume may be incorrectly bound —

The preface can be found following plate 37.

Regards

R Rockwell 1930

Subgenus DENTALIUM (restricted).

Shell prismatic or decidedly ribbed, the ribs often very strong toward the apex, where there are generally from 4 to 14, but sometimes as many as 20. Apex with no notch or slit, or a short one.

I. Shell decidedly colored, generally green.

a. Shell large, strong and stout, rapidly enlarging, the length 5 or 6 times the diameter

Group of D. elephantinum, p. 1.

a'. Shell long and slender, length 9–12 times the diameter

Group of D. aprinum, p. 3.

II. Shell white or pale.

a. 6 to about 20 ribs or riblets at apex, which is without slit (though rarely with a slight notch). Circular sculpture not conspicuously developed

Group of D. octangulatum, p. 5.
Group of D. agassizi, p. 26.

a'. Shell latticed by circular lamellæ or striæ crossing longitudinal riblets *Group of D. carduus*, p. 29.

a''. Square at apex, with four right angles

Group of D. quadrapicale, p. 31.

Group of D. elephantinum.

Shell strong and stout, rapidly enlarging, the length 5 or 6 times the diameter, with strong continuous ribs; deeply colored. Apical slit or notch small.

The two species of this Oriental group are not very closely allied. They differ from the groups of *aprinum* and *octangulatum* in being notched or slit at the apex.

a. Shell dark green, pale at apex, with about 10 ribs *elephantinum*.

b. Shell red, green and white, with 13–15 ribs *formosum*.

D. ELEPHANTINUM Linné. Pl. 1, figs. 1, 2, 3, 4, 5, 6, 7.

Shell robust, the greatest diameter somewhat less than one-sixth the length, solid, strongly curved; dark green, fading to white at the anal opening. Sculpture, about 10 (9–11) strong, projecting rounded longitudinal ribs, narrower than their intervals, which are concave, with one or several weak, low riblets; growth striæ delicate, inconspicuous. Aperture sub-circular, scarcely oblique, modified by the ribs, especially on the concave side; anal orifice circular,

its edge excavated within and slightly notched excentrically on the convex side (fig. 6). Length 70, diam. at aperture 11·5×11 mill.; height of arch above chord 15·5 mill.

Amboyna (Rumphius); *Philippine Islands* (Phil. Acad. Coll.).

D. elephantinum Linn., Syst. Nat. (10), p. 785 (1758); Ibid (12), p. 1263 (1766).—Gmel., Ibid (13), p. 3736 (1788).—Lam., Syst. An. s. Vert., p. 326 (1801); Anim. s. Vert., v, p. 343 (1818).—Wood, Index Testac., p. 183, No. 2 (1818).—Sowb., Thes. Conch., iii, p. 102, pl. 223, f. 4 (1860); and in Reeve, Conch. Icon., xviii, pl. 1, f. 5.—Chenu, Illustr. Conchyl., pl. 1, f. 4–10.—Hanley, The Shells of Linnæus, p. 435.—Sowb., The Genera of Shells, *Dentalium*, f. 1; Zool. Jour., iv, p. 196. Not *D. elephantinum* Brocchi, Conch. Foss. Subapp., ii, p. 260 (1814), nor of Philippi, Enum. Moll. Sicil., i, p. 245; ii, p. 206, nor of Desh., 1825, nor of Risso, 1826, p. 399. See *D. delessertianum* Chenu.

D. arcuatum Gmel., Syst. Nat. (13), p. 3738 (1788).—Anton, Verzeich., p. 25.—*D. elephantium* Born, Mus. Cæs. Vindob., p. 431. —? *D. recurvum* Dh., (by error ?), Monogr. Dent., p. 30.—*D. striatum* (in part) Born, l. c., p. 431.

A well known species, well distinguished by its robust form, green color and (usually) ten strong ribs. The apical orifice often has a slight rim, as in *D. entalis;* and the short notch is situated between two of the ribs a little aside from the median line of the convex side.

D. formosum Adams & Reeve. Pl. 1, figs. 9, 10, 11.

Shell arcuate, rather tumid, 13-ribbed, the ribs rounded, interstices rather wide. Anal end slit, the slit on the convex side, wider toward the apex. Very beautifully variegated with rose, olive-green and white (*A. & R.*). Length 60, greatest diam. 13·5 mill. (from fig.).

Sooloo Archipelago, outside a coral reef near the city of Sooloo, in about 16–20 fms., sandy mud (Adams).

D. formosum A. & R., Zool. H. M. S. Samarang, Moll., p. 71, pl. 5, f. 1 *a*, *b* (1848).—Sowb., Thes. Conch., iii, p. 102, pl. 223, f. 2 (1860).—Sowb. in Reeve, Conch. Icon., xviii, pl. 2, f. 7 (1872).

Of rather lighter and more tumid growth than *D. elephantinum*, richly variegated with rose, olive-green and a little white. Sowerby figures and describes it as with 15 ribs.

Group of D. aprinum.

Shell slender and long, well curved, green, with few or many longitudinal ribs. No apical slit.

Key to species.

I. 9 to 12 conspicuous, narrow ribs from apex to aperture.
  a. Interstitial sculpture weak — *aprinum*, p. 3.
  a'. Small interstitial riblets — *interstriatum*, p. 4.
II. 8 ribs, intervals wide and flat — *javanum*, p. 4.
III. Numerous riblets, 17 at apex, about 25 at aperture — *letsoncæ*, p. 4.

D. APRINUM Linné. Pl. 1, figs. 8, 12, 14.

Shell long, slender and well curved, the diameter about one-twelfth the length; solid, glossy, pale green, usually somewhat lighter toward the anal end. Sculpture, 9–12 conspicuous but narrow rounded longitudinal ribs, separated by much wider, flat, polished intervals, often parted by a faint median riblet, and usually showing numerous very slight longitudinal striæ; the ribs stronger on the concave side; growth striæ inconspicuous. Aperture circular; anal orifice very small and circular, its edge crenated by the ribs; no slit. Length 70, greatest diameter 6 mill.

Zebu, Philippine Is. (Cuming).

D. aprinum LINN., Syst. Nat. (12), p. 1263 (1766).—HANLEY, The Shells of Linn., p. 436.—GMEL., Ibid (13), p. 3736.—LAM., An. s. Vert., v, p. 343 (1818).—DESH., Mem. Soc. Hist. Nat. Paris, vii, p. 351, pl. 16, f. 18 (1825).—SOWB., Thes. Conch., iii, p. 102, pl. 223, f. 5, 6; and in Conch. Icon., xviii, pl. 1, f. 2 *a*, *b*.—CHENU, Illustr. Conchyl., p. 2, pl. 1, f. 11, 12.—*D. caprinum* ANTON, Verzeich., p. 25, (1839).—*D. striatulum* GMEL., Syst. Nat. (13), p. 3738 (1788).—WOOD, Index, p. 84, No. 4.—*D. striatum* (in part), BORN, Test. Mus. Cæs. Vindob., p. 431.

Not *D. aprinum* RISSO, Hist. Nat. Eur. Mérid., iv, p. 399 (1826).—BROCCHI, Conch. Foss. Subappen., ii, p. 264 (1814).—COSTA, Fauna Reg. Nap., p. 34 (1850), or of other authors on Italian mollusks.

The Japanese multangular tusk shells are nearly allied, but are white, while *aprinum* is pea green in color.

D. INTERSTRIATUM Sowerby. Pl. 1, fig. 15.

Shell strongly arcuate, green, narrow; primary ribs about 10, with smaller ones in the interstices; apex entire (*Sowb.*).

Bohol, Philippines, (Cuming); *Amboina.*

D. interstriatum SOWB., Thes. Conch., iii, p. 102, pl. 223, f. 7 (1860); Conch. Icon., xviii, pl. 2, f. 10.

Resembling *D. aprinum*, but with numerous interstitial striæ (*Sowb.*). We have seen no authentic specimen of this form, but from the description and figures would be disposed to consider it a variety of *D. aprinum* with somewhat stronger interstitial striæ than usual.

D. JAVANUM Sowerby. Pl. 4, fig. 49.

Shell strongly arcuate, pale tawny or greenish, angulated by 8 ribs, the interstices wide and flat; apical slit small. Differing from *D. aprinum* in having 8 instead of 10 ribs, with broad flat surfaces between. (*Sowb.*).

Length 77, greatest diam. 7 mill. (from orig. fig.).

Length 48, greatest diam. 3·6 mill.

Java, Malacca (Sowb.); *Torres Strait, Cape York,* 3–11 fms.; *Wednesday Island,* 8 fms.; and *west of Cape York, south of New Guinea,* 28 fms. (Challenger).

D. javanum SOWB., Thes. Conch., iii, p. 102, pl. 223, f. 12 (1860). —REEVE, Conch. Icon., xviii, pl. 3, f. 14, (1872).—WATSON, Challenger Scaph., p. 12.

Watson remarks that *D. octogonum*, which this very much resembles, has much stronger intercostal striæ and the ribs are much more sharply prominent. It may be added that in *octogonum* the calibre increases more rapidly, and the shell is more curved. The aperture of *D. javanum* is as wide as long, and distinctly octagonal. The single specimen we have seen is nearly white.

D. LETSONÆ Sharp & Pilsbry, n. sp. Pl. 1, fig. 13; pl. 5, figs. 66, 67, 68.

Shell long and slender, the length about 12 times greatest diameter, solid, but rather thin, well and equally curved; *pale green,* with numerous indistinctly defined darker zones. *Sculpture, 17 longitudinal riblets at the apex, increasing to about 25 at aperture,* rather unequal in size and strength, but not conspicuously so, the smaller ones being intercalated irregularly; all the main riblets

rather wide and rounded, generally wider than the intervals; the concave side as a whole with stronger sculpture than the convex side; growth striæ faint. Aperture slightly compressed laterally, not oblique. Anal orifice shortly ovate, the narrower end toward the convex side; no slit or notch.

Length 75, length of aperture 6, breadth 5·5 mill.; diam. of apex 2 mill.; height of arch from chord 13 mill.

Island of Bohol, Philippines.

With the color and general shape of *D. aprinum*, this species presents less prominent and many more longitudinal riblets, without trace of the definite arrangement seen in that species. It is not especially related to *aprinum* except in being of a green color. The aperture is noticeably compressed from side to side. The figures on pl. 5 represent the sculpture at the apex and aperture, with an outline of the latter.

Group of D. octangulatum.

White shells with 6 to 13 strong ribs at the apex, continuing to the aperture or becoming obsolete, the intervals either smooth, with several striæ, or a median riblet. Apex small; anal orifice simple, without terminal "pipe," slit, or notch (with very few exceptions where a short slit occurs).

An Indo-Pacific, West American and West Indian group, with shells somewhat like the group of *D. entalis* but not colored, and without the notch, sheath or other apical peculiarities frequently developed in that series.

Some species possibly belonging to this group have been placed in the group of *D. disparile*, q. v.

So many of the species are unfigured and insufficiently described that a satisfactory "key" to them cannot now be constructed. The Australian forms particularly are but little known. In the absence of something better, the following synopsis may be found of some use.

Key to Species.

I. Hexagonal or six ribbed at and near the apex.

a. No large intercalated riblets toward aperture.

b. Intervals smooth, with several striæ toward aperture; length 55 mill., 12 to 14 times the diameter. Oriental, *hexagonum*, p. 18.

b'. Smaller shells; length 15 to 35 mill., 10–14 times the diam.

c. West American, *neohexagonum*, p. 19.

c'. West Indian, *gouldii*, p. 20.

b''. Apical orifice contracted at the sides, *picteti*, p. 22.

a'. 12 equal or subequal ribs at aperture, *intercalatum*, p. 23; *duodecimcostatum*, p. 13.

a''. Each interval divided and subdivided by successively arising riblets, *pseudosexagonum*, p. 23; *oerstedi*, p. 24.

II. Seven ribbed at and near the apex.

a. 14 ribs from aperture to middle; length 14 mill., 7 times the diam., *katowense*, p. 9.

a'. Interstitial riblets toward the round aperture; length 14 mill., 10 times the diam.; a minute apical slit, *cheverti*, p. 9.

a''. 7–8 thick ribs and interstitial threads; length 72 mill., 12 times the diam., *japonicum*, p. 17.

a'''. 6–7 ribs, interstices smooth or becoming striate toward aperture; length 50–55 mill., 12–14 times the diam., *hexagonum*, p. 18.

III. Eight ribbed at and near the apex.

a. Ribs strong and very prominent; interstices deeply concave, with some riblets in adult shells.

b. 7–8 thick ribs; length 72 mill., about 12 times the diam., *japonicum*, p. 17.

b'. 8–9 strong ribs; length 50 mill., about 10 times the diam., *octangulatum*, p. 16.

b''. 8 strong ribs; length 10½ mill., about 7 times the diam., *tasmaniensis*, p. 9.

a'. Ribs narrower, less prominent; interstitial riblets wanting or very weak.

b. Pale tawny or greenish; intervals wide, flat; a small apical slit; length 48–77 mill., 11–13 times the diam., *javanum*, p. 4.

b'. White, slender, thin, ribs narrow, interstices transversely striated; length 65 mill., 13 times the diam., *filosum*, p. 13.

b''. 8–9 equal rounded ribs, intervals unequal, shallow, with some threads; length 30 mill., 8 times the diam., *yokohamense*, p. 16.

IV. Nine ribbed, the ribs sometimes obsolete near aperture.

a. Ribs rounded, distant, interstices flat; length 20 mill., 8 times the diam., *robustum*, p. 12.

a'. Ribs slender, intervals unequal, shallow, with slight threads; length 30 mill., 8 times the diam. (Japan), *yokohamense*, p. 16.

a''. Ribs strong, equidistant, surface finely lineolate; length 40–48 mill., about 7 times the diam. (Suez), *lineolatum*, p. 11.

a'''. Ribs strong, wide, unequally spaced, surface finely striated; length 45 mill., about 7½ times the diam. (W. Atlantic), *laqueatum*, p. 10.

a''''. Ribs strong, intervals deeply concave with a few riblets; length 50 mill., about 10 times the diam. (Japan), *octangulatum*, p. 16.

a'''''. Ribs rounded, obsolete toward aperture; length 50 mill., about 12½ times the diam. (Papua), *lessoni*, p. 8.

V. Ten to thirteen ribs at and near apex, sometims obsolete near aperture.

a. Surface finely longitudinally striated on interstices and ribs.

b. 9–11 wide ribs, subobsolete toward aperture; length 45 mill., about 7½ times the diam., *laqueatum*, p. 10.

b'. 11–12 distinct ribs, intervals and some ribs lineated; length 37 mill., 9 times the diam., *aratorum*, p. 10.

b''. 13 strong, sharp ribs, without interstitial riblets; surface finely striated longitudinally; length 15–18 mill., 6 times the diam., *strigatum*, p. 13.

a'. Surface not longitudinally striated, interstitial striæ few or none.

b. 10 rather sharp ribs, intervals nearly flat, not lirate; length 20 mill., about 7 times the diam., *decemcostatum*, p. 8.

b'. 8–10 ribs, disappearing toward aperture, length 50 mill., about 12½ times the diam., *lessoni*, p. 8.

b''. 11–13 strong, narrow ribs, intervals with a weak thread or none; length 70 mill., 11–12 times the diam., *bisexangulatum*, p. 15.

VI. Twelve to fourteen ribs at apex, increasing to about double that many at aperture.

a. 12 delicate longitudinal riblets increasing to 20; length 20 mill., 8 times the diam., *porcatum*, p. 15.

a'. 14 narrow ribs, increasing to 28 equal ones at aperture; length 16 mill., about 7 times the diam., *buccinulum*, p. 14.

D. LESSONI Deshayes. Pl. 6, figs. 86, 90.

Shell rather straight, cylindrical, whitish-gray, with 8 to 10 ribs, ribs obtuse, depressed, disappearing at the aperture.

Allied to *D. novemcostatum*, but distinguished by form, curvature, and disposition of the ribs. It is narrower, longer, less curved, constantly of a yellowish-white uniform color, without transverse zones. The ribs, numbering 8, 9 or 10, are contiguous at their bases, moderately raised and rounded. They are more elevated toward the apex, diminishing gradually and disappearing toward the aperture. They are interrupted by some growth lines. The aperture is small relative to the length of the shell.

Length 50, diam. 4 mill. (*Desh.*).

New Guinea (Lesson).

D. lessoni DESH., Mém. Soc. Hist. Nat. Paris, ii, p. 357, pl. 16, f. 13 (1825).—CHENU, Illustr. Conchyl., i, *Dent.*, p. 5, pl. 4, f. 4 (not 4a). Not *D. lessonii* Sowerby, 1860, 1872.

Lesson brought a necklace of four strings, composed entirely of this species, from New Guinea, presumably procuring it from the natives. The Mediterranean shells identified in the Thes. Conch. and Conch. Icon. as *D. lessoni* are *D. panormum* Chenu. Whether *D. lessoni* of Sowerby's "Marine Shells of South Africa," p. 48, is the true *lessoni*, or some allied species, we do not know; but it is more likely *D. strigatum* Gld.

D. DECEMCOSTATUM Brazier.

Shell tapering, thin, white, slightly arched, longitudinally 10-ribbed, ribs somewhat sharp, interstices nearly flat, transversely finely striated, apex with a small perforation; basal aperture large, circular. Length 10 lines, diam. of apex ¼, diam. of base 1½ lines (*Brazier*).

Katow, New Guinea, 8 fathoms, sandy mud (Chevert Exped.).

D. decemcostatum BRAZ., Proc. Linn. Soc. N. S. Wales, ii, p. 55 (1877).

D. TASMANIENSIS Tenison-Woods.

Shell small, solid, white, slender, slowly increasing, slightly curved; equally 8-ribbed, the intervals often subcostate; apex entire. Length 10·5, diam. 1·5, diam. of apex 0·5 mill. (*T.-W.*).

Northwest coast of Tasmania (W. F. Petterd).

D. tasmaniensis T.-W., Papers and Proc. and Rep. Roy. Soc. Tasmania, for 1876, p. 140 (1877).

Evidently a member of the *D. octangulatum* group. "This is a gracefully tapering shell, curved slightly, with valid ribs and often smaller ones in the interstices."

D. aratum Tate and *D. nanum* Hutton, of the South Australian and New Zealand tertiaries respectively, are allied species of this group.

D. WELDIANUM Tenison-Woods.

Shell small, subcylindrical, shining, whitish, somewhat pellucid; slightly curved; obsoletely equally ribbed; apex entire. Length (decollated) 10, diam. 1·5, diam. of apex 1 mill. (*T.-W.*).

North coast of Tasmania (W. F. Petterd).

D. weldiana T.-W., Papers and Proc. and Rep. Roy. Soc. Tasmania for 1876, p. 140 (1877).

An almost cylindrical shell, subpellucid and shining, with obsolete ribs (*T.-W.*).

D. CHEVERTI Sharp & Pilsbry, n. n.

Shell white, slightly arched, 7-ribbed, ribs somewhat sharp, having finer ones between, extending from the base to the center, interstices with fine transverse silk-like striæ; apex perforated, perforation with a minute notch-like fissure on the dorsal margin; aperture circular, entire. Length, 7 lines; diam. apex, $\frac{1}{4}$; base, $\frac{3}{4}$ lines [14, 0·5, 1·5 mill.] (*Braz.*).

Evans' Bay, Cape York, north Australia, 6 fathoms, sand (Chevert Exped.).

D. septemcostatum BRAZ., P. L. S. N. S. W., ii, p. 57 (1877). Not *D. septemcostatum* Abich, 1859.

D. KATOWENSE Brazier.

Shell white, thin, transparent, slightly arched near the apex; 7-ribbed, from the center to the base 14, those above being most conspicuous; interstices with minute lengthened striæ; apex thickened; perforation small, entire; aperture circular. Length, 7 lines; diam. of apex, $\frac{1}{2}$; base, 1 line (*Brazier*).

Katow, New Guinea, 8 fathoms, sandy mud and coral (Chevert Exped.).

A white species with 14 ribs on the base, having 7 at the apex more defined (*Braz.*).

D. katowense Braz., P. L. S. N. S. W., ii, p. 56 (1877).

D. aratorum Cooke. *Unfigured.*

Shell solid, pale amber-colored, acuminate, arcuate, not very strongly but distinctly fluted with 11 or 12 ribs, the interstices and some of the ribs themselves longitudinally strongly lineated, impressed interstitial lines about 4; apex entire.

Length 1·5, width at base 0·15 inch (*Cooke*).

Gulf of Suez, 10–30 fms. (MacAndrew).

"*D. belcheri* Sow. [*aratorum* Cooke]" Cooke, Annals and Mag. Nat. Hist. (5), xvi, pp. 274, 275 (Oct. 1885).—*D. reevii* Desh., MSS., MacAndrew in coll. Not *D. reevei* Dh., Fischer!

Very distinct from *D. lineolatum* Cooke, which it nevertheless strongly resembles in its *sculpture*. This shell is more curved, the ribs are never less than eleven, and are comparatively obscure, while in *lineolatum* there are always nine, and they are very marked and prominent (*Cooke*).

MacAndrew perceived that "*Belcheri* Sow." was wrong, and has corrected to "*Reevii* Desh. MSS." I have no idea what this refers to, so will describe the species, which is a good one (*Cooke*).

D. laqueatum Verrill. Pl. 7, figs. 1, 2 (immature); pl. 5, fig. 73.

Shell rather large, thick and strong, moderately stout, gradually tapered, gently curved, chiefly behind the middle. The sculpture consists of *about eleven* [9 to 11] *strong, prominent, broad, obtuse, longitudinal ribs, separated by deep, concave interspaces*, which are wider than the ribs in the middle of the shell and of about the same breadth posteriorly; *at about the anterior third the ribs decrease in prominence*, fading out, or becoming flattened into mere obtuse angles at the anterior end; *along the middle of the shell a smaller rib* [or two] *intervenes between part of the larger ones;* four of the ribs on the convex side are closer together and narrower than the rest, while those on the concave side are widest apart. Between the ribs the whole surface is covered with regular, fine and close, microscopic longitudinal lines, which also cover the ribs where they are not worn. Distinct and rather close lines of growth cover the

surface, and, in some places, make with the longitudinal striæ a fine reticulated structure. Anterior aperture nearly round, but slightly angulated in line with the principal ribs; edges thin, but the shell is thickened and the interior is circular farther back. The posterior end is rather small, with a very small aperture, the shell being thickened, but the tip is so eroded as to render uncertain the existence of a slight notch. Color dull grayish-white. Length 45, diameter of large end 6, of small end 3 mill. (*Verrill*).

D. laqueatum VERRILL, Trans. Conn. Acad., vi, p. 431, pl. 44, f, 18 (1885).—DALL, Blake Rep., Bull. M. C. Z., xviii, p. 426, pl. 27, f. 1; Bull. U. S. Nat. Mus., No. 37, p. 76, pl. 27, f. 1 (1889).

Off Martha's Vineyard and Chesapeake Bay in 68 fms. (U. S. Fish Commission); from *near Cape Hatteras, North Carolina, to the vicinity of Cape Florida*, abundant (Blake Expedition); at Station 9, *Gulf of Mexico*, in 127 fms.; *off Sombrero*, living, in 54 fms.; *off Havana*, in 127 to 177 fms. (Sigsbee); *off Santa Cruz*, in 115 fms.; *off Dominica*, in 118 fms., sand; *near the Grenadines*, in 164 fms., coral; *off Grenada*, in 154 fms., ooze; *near Barbados*, in 73–84 fms. (Blake Exped.).

This species is easily distinguished from all others of our coast by the very large and strong longitudinal ribs, and the fine longitudinal striæ between them (*Verrill*).

This very fine species reaches the length of 55 mill. The very young have generally a very slight wave on the convex side of the anal aperture; in the adults this aperture is somewhat circular and unslit; sometimes there is a narrow slit 5 mill. long. The very young have the transverse sculpture most prominent (aside from the strong ribs which range from 9 to 11), the adolescent part the longitudinal striæ; while near the lip of the adult both are obsolete. I am disposed to think the species does not reach more than 200 fms. (*Dall.*).

It recalls *D. octangulatum* Don. somewhat, but the secondary striæ in that species, when present, are generally more numerous, the primary ribs fewer, and the taper at the posterior end much more abrupt.

D. LINEOLATUM Cooke. *Unfigured.*

Shell solid, pale amber colored, acuminate, curved toward the apex, fluted with 9 angulated, very high, equidistant ribs; interstices and some of the ribs themselves longitudinally lineated, and

decussated by very minute transverse striæ. Apex entire. Length 1·75, breadth at base 0·25 inch (*Cooke*).

Gulf of Suez (MacAndrew).

D. lineolatum Cooke, Ann. Mag. Nat. Hist. (5) xvi, p. 274 (Oct., 1885).

In fresh specimens the interstitial lines are very marked; they are parallel to the ribs, which are themselves generally bisected by a similar line (*Cooke*).

D. laugieri Jouss. and *D. reevei* Desh. seem to be identical with, or at least very nearly allied to, this species. Although *reevei* has priority, the absence of a sufficient description would lead us to adopt Cooke's name should the specific identity of these forms be confirmed. The descriptions here follow:

D. laugieri Jousseaume. Shell white, solid, cylindrical, slightly arcuate, longitudinally costate; ribs 9, equal, strong, rounded, smooth; the intervals flat, wider, with 3 to 5 delicate striæ. Length 40–48, diam. 7 mill. (*Jouss.* in Bull. Soc. Philomath. de Paris, (8), vi, p. 103, 1894).

Aden; Suez.

This form seems to present no tangible differences from *D. lineolatum* Cooke, and from comparison of the diagnoses we believe it a synonym.

D. reevei "Deshayes" Fischer. This species, which will shortly be described by M. Deshayes, is white, arcuate, having 9 longitudinal ribs. The interstices are very finely striated transversely, and some longitudinal narrow ribs run along them. (*D. reevei* Deshayes, mss., *Fischer*, Journ. de Conchyl., xix [(3), xi], p. 212, 1871).

Suez.

The above insufficient descriptive note is all that has been published on this species. Compare *D. laugieri* Jouss. and *lineolatum* Cooke, with which *reevei* is probably identical.

D. robustum Brazier.

Shell nearly straight, thick, dull white, longitudinally 9-ribbed, ribs rounded, wide apart, narrow toward the apex, interstices flattened, smooth; apex with small perforation, entire; aperture thickened, regular. Length 10 lines, diam. of apex $\frac{3}{8}$, base $1\frac{1}{4}$ line (*Brazier*).

Katow, New Guinea, 8 fathoms, sandy mud and coral (Chevert Exped.).

D. robustum Braz., P. L. S. N. S. W., ii, p. 56 (1877).

D. DUODECIMCOSTATUM Brazier.

Shell straight, white, thin, shining, smooth, six-sided, having two longitudinal rounded ribs, one on the edge of each square, from the center between the interstices one fine rib extending to the base, making in all 12 ribs; apex tapering, entire, with minute perforation; aperture large. Length 11 lines, diam. of apex ¼, base 1 line (*Braz.*).

Darnley Island, Torres Straits, 30 fathoms, sandy mud (Chevert Exped.).

D. duodecimcostatum BRAZ., P. L. S. N. S. Wales, ii, p. 56 (1877).

Only one specimen found. It differs from anything at present known. The shell is six-sided, the base with twelve ribs, and from the center to the apex six, with the interstices smooth (*Brazier*).

D. FILOSUM Broderip & Sowerby.

Shell slender, thin, white; with 8 longitudinal threads and very close transverse striæ. Length 2·6, diam. 0·2 inch (*B. & S.*).

Tenasserim, on shore.

D. filosum B. & S., Zoological Journal, v, p. 48 (1830–1832).

Distinguished from *D. octogonum* by its much more slender shape and its thinner shell. Instead of the eight angles of that species it has eight distinct, raised, longitudinal threads. Three specimens of this fine species were lately brought to England by Mr. Hay, who himself picked them up on the coast of Tennasserim (B. & S.).

It is somewhat peculiar that this apparently distinct and large species has not been noticed by any author since its original description. Compare *D. javanum*.

D. STRIGATUM Gould. Pl. 5, figs. 69, 70.

Shell considerably curved, solid, rapidly tapering; surface lusterless, white with several irregular transverse grayish-translucent bands. Sculpture of *13 strong and rather sharp ribs continuous from end to end*, separated by wider *deeply concave intervals*; no trace of interstitial riblets; *intervals and ribs longitudinally very finely striated*. Aperture hardly oblique, circular, the peristome strongly scalloped by the ribs, which are represented by grooves within the tube. Anal orifice much smaller than the truncated apex, oblong, with a raised ledge at each side.

Length 15·2, breadth at aperture 2·4, at apex 0·9 mill.

Length 18, breadth at aperture 3 mill.

False Bay, Cape of Good Hope (N. Pacif. Expl. Exped.).

D. strigatum Gld., Proc. Bost. Soc. N. H., vii, p. 166 (1859); Otia, p. 119.

Considerably like *D. bisexangulatum* on a small scale, but the concave intervals and sides of the ribs are finely and evenly striated longitudinally as in *D. lineolatum*. Figures and description from one of the original specimens, in U. S. Nat. Mus. (no. 24189).

D. buccinulum Gould. Pl. 5, figs. 74, 75, 76; pl. 6, fig. 84.

Shell rather rapidly tapering, solid, the smaller half considerably curved, later half straight; lusterless, white. Sculpture of 14 narrow, rather sharp ribs at the smaller end, separated by wider, deeply concave intervals; at the middle of the shell a thread arises in each interval, those on the convex side appearing first, and at the aperture there are 28 equal riblets parted by shallow intervals as wide as themselves. Aperture oblique, circular. Anal orifice small, ovate, with an extremely slight notch on the convex side. Length 16, diam. at aperture 2·2, at apex 0·7 mill.

Kagosima, Japan (N. Pacif. Expl. Exp.).

D. buccinulum Gld., Proc. Bost. Soc. N. H. vii, p. 166 (1859); Otia, p. 119.—Sowb., Conch. Icon., xviii, pl. 7, f. 50.

The specimen described above and figured on pl. 5 is not full grown. Traces of tertiary threads at the aperture show that a larger shell would have more riblets. It is no. 24160 U. S. Nat. Mus. Gould's description here follows:

Shell moderate, milk white, ruddy toward the apex, very arcuate; longitudinally grooved by about 30 sulci, which vanish toward the aperture. Length 30, diam. 3 mill. Most nearly allied to *D. curtum*, but is more deeply grooved. (*Gld.*).

Sowerby quotes this and Gould's other species, as MSS. names in the British Museum; but they were all diagnosed by Gould many years ago in as well-known a work as the Otia Conchologica. The locality "Hong Kong" given in the Iconica is incorrect.

D. curtum Sowerby. Pl. 10, fig. 65.

Shell greenish, subcylindrical, delicately striated, short. Apex obtuse, slightly fissured. A small, cylindrical, pale-greenish shell, with obtuse apex and fine striæ. (*Sowb.*). Length 20½, diam. 3 mill. (from fig.).

Habitat unknown.

D. curtum—?, Sowb., Thes. Conch., iii, p. 100, pl. 225, f. 62, under figs. 47, 48 (1860); Conch. Icon., xviii, pl. 6, f. 42 (1872).

Short, pale brown, finely striated, strongly arched, rapidly increasing; apex attenuated and acuminated; apical fissure small. (*Sowb.*).

D. PORCATUM Gould. Pl. 6, fig. 80.

Shell moderate, chalky, more or less ruddy at the apex, well curved, with 12 delicate longitudinal sulci, increasing to 20. Length 20, diam. 2·5 mill. (*Gld.*).

Hongkong Harbor, China (N. P. Expl. Exped.).

D. porcatum Gld., Proc. Bost. Soc. N. H., vii, p. 166 (1859); Otia Conch., p. 119.—Sowb., C. Icon., xviii, pl. 7, f. 47.

D. BISEXANGULATUM Sowerby. Pl. 2, fig. 25.

Shell well curved, solid, moderately stout, the length about 11 or 12 times the greatest diameter; white. Sculpture of about 12 (11 to 13) strong longitudinal narrow ribs, about a third as wide as the concave intervals, which are ribless or show a weak median thread on the convex side (or occasionally all the intervals except one or several on the concave side have low median threads); growth-striæ fine and superficial. Aperture a trifle compressed laterally, strongly angulated by the projecting ribs on the concave margin, but much less so in adult shells on the convex margin. Anal orifice rounded, with a wide, shallow notch on the convex side.

Length 68, length of aperture 6·5, breadth 6 mill.; height of arch from chord 10 mill.

Length 72, length of aperture 6·2, breadth 6 mill.; height of arch from chord 11·5 mill.

Java (Sowerby); *Singapore* (Archer); *Yokohama, Japan* (Loomis); *Gulf of Suez* (MacAndrew); *Torres Straits and vicinity*, 8–30 fms. (Chevert Exp.).

D. bisexangulatum Sowb., Thes. Conch., iii, p. 102, pl. 223 f. 8 (1860), and in Conch. Icon., xviii, pl. 3, f. 15 (1872).—Cooke, Ann. Mag. N. H. (5), xvi, p. 273.—Brazier, Proc. Linn. Soc. N. S. Wales, ii, p. 57 (1877).

So far as our material goes, there are oftener 11 than 12 ribs; and the development of an intermediate thread in each space over the greater part of the shell is occasional though probably exceptional.

The specimen from Yokohama which I refer to this species came with a series of *D. octangulatum*. It is 11-ribbed, and measures, length

47, length of aperture 5, breadth 4·7 mill.; height of arch from chord 9 mill. The apical third is much more curved than in the typical form, but this, like the greater ratio of diameter to length, is a character of immaturity.

D. YOKOHAMENSE Watson. Pl. 2, figs. 29, 30, 31.

Shell much curved when young becoming nearly straight with later growth, little conical, rather strong, opaque, yellowish-white, quite dull, but not chalky. Sculpture: Irregular, slightly elliptical, lines of growth, a little puckered, generally slight, but sometimes sharp and even; towards the mouth faintly imbricated; occasionally marked by a deep furrow-like construction of the shell. The *longitudinal ribs are eight to nine in number, equal, rounded, rather strong*, but not very prominent. These are parted by furrows, round and open, very shallow, and of very unequal breadth. In these furrows, one, two, or even three thread-like riblets appear, and in the whole texture the lens shows a tendency to a longitudinal or rod like structure. At the apex the shell is squarely truncate, and in the young shell there is, on the convex slope, a slight ragged fissure. Length 1·2, breadth at mouth 0·15; at apex 0·003 inch. [Length 30, diam. 3·75 mill.]. (*Watson*).

Yokohama, Japan, 8 fms. (Challenger).

D. yokohamense WATS., Journ. Linn. Soc. Lond., xiv, p. 517 (1879); Chall. Rep., p. 11, pl. 2, f. 1.

The ribs here are much less sharp than they are in *Dentalium dentalis* Linn., and there is no trace of the exquisite longitudinal fretted striæ which cover the furrows in that species. The sharp intercostal striæ of *Dentalium octogonum* are quite absent here; and in that species, which is much more bent, the ribs are much wider apart and more equally parted. (*Wats.*).

D. OCTANGULATUM Donovan. Pl. 2, figs. 16, 17, 18, 22.

Shell rather slender, the length about 10 times the greatest diameter, well curved, white or bluish-white; nearly lusterless or shining. Sculpture, 8 (rarely 9) longitudinal rounded ribs, extremely strong and prominent toward the smaller end, often lower toward the aperture, parted by deep concave intervals, smooth in the young, but usually with several or many unequal longitudinal striæ in adult specimens at least toward the larger end; growth-lines slight. Aperture somewhat oblique, octagonal, a trifle longer than wide. Anal

orifice minute, a little channelled on the convex side but without a slit.

Length 50, greatest diam. 5, least 1 mill.

Length 52, greatest diam. 5·3, least ·8 mill.

China Sea (authors); *Japan, Nagasaki*, (figs. 17, 18), *and Bay of Jeddo*, f. 16 (Lischke); *Hakodate* (Schrenck); *Kii coast* (Stearns); *Ceylon* (Tennent). *N. Australia at Cape York, Princess Charlotte Bay, Katow, New Guinea, Darnley Island, Torres Strait* (Chevert Exped.).

D. octangulatum Donovan, Nat. Hist. Brit. Shells, v, pl. 162 (1803); quoted "*octangulum*" by Turton.—*D. striatulum* (in part) Turton, Conch. Dict. Brit. Is., p. 38 (1819).—*D. aprinum* Mawe, Linn. Syst. Conch., pl. 33, f. 1 (not of Linné).—*D. octogonum* Lam., An. s. Vert., v, p. 344 (1818).—Desh, Mém. Soc. Hist. Nat. Paris, ii, p. 352, pl. 16, f. 5, 6 (1825).—Delessert, Rec. de Coq., pl. 1, f. 1 (1841).—Chenu, Illustr. Conchyl., i, p. 5, pl. 1, f. 21–23.—Sowerby, Thes. Conch., iii, p. 102, pl. 223, f. 9 (1860); and in Conch. Icon., xviii, pl. 2, f. 12 (1872).—Reeve, Conch. Syst., ii, pl. 36, f. 8.—Lischke, Jap. Meeres-Conchyl., ii, p. 103; iii, p 75, pl. 5, f. 1–3 (1874).—Dunker, Index Moll. Mar. Jap., p. 153.—Brazier, Proc. Linn. Soc. N. S. Wales, 1877, ii, p. 55.—? *D. octagonum* Angas, P. Z. S., 1878, p. 868 (Henley Beach, South Australia). Not *D. octagonum* Costa, Fauna Reg. Nap., Dent., p. 19, pl. 1, f. 6 (1850).—*D. octohedra* Leach, ms. label in Jeffreys coll.

Out of 32 specimens before us from Japan, 2 have nine equal and equidistant ribs, and in another one rib is replaced by two contiguous smaller ones. The young are much more curved than adults; and in the latter the larger half of the length is scarcely arcuate. The number of ribs is practically the chief character separating this from *D. sexcostatum*.

In some specimens the primary ribs become much lower toward the aperture, which, while still octagonal, has the angles rounded off, not projecting as in the typical form.

Donovan supposed the species to be British; but there can be no doubt whatever of the identity of his types with the Lamarckian *D. octogonum*. After arriving at this conclusion we found that Deshayes, in his MS. card catalogue, had adopted the same view.

D. japonicum Dunker. Pl. 2, fig. 19.

Shell solid, white, becoming yellowish toward the apex, a little arcuate; having 7 or 8 thick ribs, and interstitial riblets; trans-

versely striated; apex rather large, entire, without a slit. Length 72, diam. 6 mill. (*Dkr.*).

Japan (Dkr.).

D. japonicum Dkr., Malak. Bl., xxiv, p. 68 (1877); Index Moll. Mar. Jap., p. 153, pl. 5, f. 2.

Not unlike *D. javanum* Sowb., but easily distinguished by being more slender, with stronger interstitial riblets and the whole sculpture more prominent. (*Dkr.*).

It is evidently near *D. octangulatum*, but the diameter increases less rapidly, the aperture being contained twelve times in the length. Not seen by us.

D. hexagonum Gould. Pl. 2, figs. 20, 21, and var. 23, 24.

Shell long, slender, bony, arcuate, hexagonal with obtuse, laterally compressed angles, the interspaces unsculptured; peristome six-angled. Length 55, diam. 4 mill. (*Gld.*).

Hongkong (N. Pacif. Expl. Exped.); *Singapore* (Sowb., Archer!); *Bay of Yeddo, Japan* (Lischke).

D. hexagonum Gld., Proc. Bost. Soc. N. H. vii, p. 166 (Dec., 1859); Otia Conch., p. 119.—Sowb., Thes. Conch., iii, p. 103, pl. 223, f. 10 (1860) and in Conch. Icon., xviii, pl. 2, f. 6 (1872).—Lischke, Jap. Meeres-Conchyl. iii, p. 74, pl. 5, f. 4, 5 and *var.*, f. 6, 7 (1874).

Not "*D. hexagonum* Sby." of Carpenter and other authors on West American mollusks.

Several specimens of the original lot are before us, with others collected by Archer at Singapore. These have sharply cut, high and rather narrow ribs, separated by flat or concave intervals showing lines of growth only, although in the largest there are faint traces of interstitial striæ. One out of 5 from China is 7-ribbed (see below). There is no apical slit. The shell is somewhat more slender than *D. octangulatum*, the diam. of aperture being contained 12 to 14 times in the length of shell.

Lischke writes as follows: Gould's diagnosis agrees excellently with the 16 examples before me, except that the intervals are plain only in the smaller part of the shell to about 20–25 mill. from the apex, beyond there having very fine interstitial riblets. These riblets become more numerous toward the aperture, but they vary in number, not only in different specimens but in the different intervals on

the same shell; usually being 1–3, exceptionally 4, or even 6. My largest example has a length of 50, breadth 4 mill. With the 16 six-ribbed specimens, there are 4 with *seven* primary ribs, the largest one 41 mill. long. These were received with the others, and are exactly like them except in the number of ribs (pl. 2, figs. 23, 24). All the seven ribs run from apex to aperture, and the latter is as pronounced a heptagon as that of the typical form is a hexagon.

Var. SEXCOSTATUM Sowerby. Pl. 2, figs. 27, 28.

Shell slender, its smaller half well curved, larger half nearly straight; white. Sculpture of 6 very strongly projecting rounded ribs, about half as wide as their interstices; the latter on the smaller third of the shell concave and plain, beyond that, one or two interstitial threads appear in each interval on the convex side, and later in those on the concave side; these increasing in number until near the aperture there are 3–6 unequal threads on the flat ground of each interval. Aperture hexagonal, the angles more or less projecting. Anal orifice a minute ovate foramen, excentric in position on the star shaped apex; no slit or notch. Length 62, breadth and length of aperture 5 mill.

Japan, Cape Shima, 18 fms.; *Goza Harbor*, 6 fms. (St. John); *China* (Sowerby).

D. sexcostatum SOWB., Thes. Conch., iii, p. 103, pl. 223, f. 11 (1860) and in Conch. Icon., pl. 2, f. 11 (1872).—E. A. SMITH, Ann. Mag. N. H., xvi, 1875, p. 113. Conf. LISCHKE, Jap. Meeres-Conch., iii, pp. 74, 75.

This differs from typical *hexagonum* in the more sculptured intervals, thicker ribs and larger size, but we have little doubt that the forms intergrade.

D. NEOHEXAGONUM Sharp & Pilsbry, n. sp. Pl. 11, figs. 74–86.

Shell decidedly curved toward the apex in the young, only moderately arcuate when adult; slender (the length 12–14 times the greatest diameter, in adults); much attenuated toward the apex; white. Sculpture of *six strong*, rounded, *projecting ribs*, which on the larger half or third of the adult shell *become reduced to mere rounded angles;* interstitial riblets wanting, or with one or two low cords developed in each interval toward the larger end of the shell only; usually with coarse wrinkles of growth on the larger half of the length Aperture hexagonal, but with the angles so rounded as to appear almost circular; oblique; anal orifice rounded-oval, without notch or slit.

Length 30·5, diam. of aperture 2·5 mill.; height of arch from chord 4·8 mill.

Length 31·5, diam. of aperture 2·3 mill.; height of arch from chord 3·7 mill.

Santa Barbara, San Pedro Bay, San Diego, California (south to Acapulco?). *Fossil in southern Californian Pliocene.*

"*D. hexagonum* Sby.," Cpr., Suppl. Rep. Moll. West Coast N. A., in Rep. Brit. Asso. Adv. Sci. for 1863, pp. 612, 648 and 668 ("*D. ? hexagonum*, var. *B*"); and in The Mollusks of Western North America, Smiths. Misc. Coll., no. 252, pp. 98, 134, 154 (1872).—Gabb, Palæont. of Calif., ii, 1869, p. 86.—Williamson, Proc. U. S. Nat. Mus., xv, p. 194 (1892).—Keep, West Coast Shells, p. 114.

This species has hitherto been confused with the Japanese *D. hexagonum* Gld., a mistake apparently originating with Dr. Carpenter. It never grows as large as that form, the six primary ribs lose conspicuously in prominence on the larger part of the shell, and fewer interstitial riblets develop. The two species are very readily separated at all stages of growth, and have only been united because no comparison of Oriental and Californian specimens seems hitherto to have been made.

The young shells, as usual, are much more curved and taper more rapidly than adults. Specimens from the Pliocene at San Diego are larger than any recent shells we have seen.

There is a form of this species having 7 or even 8 ribs, (pl. 11, figs. 81, 82, 83, 86) and another with a short apical slit on both convex and concave sides of the tube (pl. 11, fig. 84). We have not seen specimens enough to be satisfied that these are more than variations of *D. neohexagonum.*

D. gouldii Dall. Pl. 7, fig. 14 (var. *obscurum*).

Shell elongated, slender, slightly arched, vitreous, anteriorly whitish, behind with a yellowish or pale greenish tinge, surface polished, with fine microscopic longitudinal striæ over a large part of the surface; in well developed specimens the shell is hexagonal and six-sided, with the sides impressed so that the ribs stand out like marginating rods; as the shell grows older, the angles become less marked, although generally quite perceptible at the aperture; the lines of growth are visible as extremely fine engraved striæ; in another mutation of the species (which served the draughtsman for fig. 14), there are longitudinal threads between those forming the

angles, and which obscure the angularity especially in front until the shell is examined from behind "end on" when it will be perceptible; this form is straighter than the type. The aperture is not at all oblique. There is a wide rather short notch, perhaps due to erosion, at the convex side of the anal orifice in the shell figured. Typical form shows no notch when perfect, and measures 30·0 mill. long, height of the arch 3·5 mill., aperture 3·0 and anal end 0·6 mill. in diameter. The variety *obscurum* is 28·0 mill. long, aperture 2·0 and anal end 0·5 mill. in diameter. (*Dall*).

Off Havana, in 127 fms. Variety at Station 299, in 140 fms. coral, *near Barbados*. Also (the typical form) at U. S. Fish Commission Station 2145, in 25 fms., mud, *near Aspinwall; Galveston and Corpus Christi, Texas* (Singley). Also in 12 fms., *twelve miles east from Frying pan shoals, South Carolina*, (Dr. W. H. Rush, U. S. N.). Also *Barbados* (fide H. Cuming), *East from Rio Janeiro*, 59 fms. (Albatross). *Eocene of Trinidad* (Guppy & Dall).

D. gouldii Dall, Blake Rep., Bull. M. C. Z., xviii, p. 424, pl. 26, f. 4 (1889); Bull. U. S. Nat. Mus., no. 37, p. 76, pl. 26, f. 4; Proc. U. S. Nat. Mus., xii, 1889, p. 295 (1890).—Guppy & Dall, Proc. U. S. N. Mus., xix, p. 325 (1896).—*D. sexangulare* Hilgard & Hopkins, Rep. Borings Miss. R. and L. Borgue, Engineers Dept. U. S. A., p. 48, pl. 3, f. 7 (1878), name preoc.—*D. texasianum* Phil. and ? *D. americanum* Chenu, see below.

The shell was confounded with *D. hexagonum* Gould, a large Chinese species of similar form, by Sowerby and Reeve. The typical form of *D. gouldii* is longer, more slender, and less curved than the figures of Reeve and Sowerby, which represent a young *D. hexagonum*. It is just possible that the supposed variety may prove distinct, in which case it may be called *D. obscurum;* but I inclined at present to believe it to be nothing more than a variety. The ordinary form is what has been called *hexagonum* by West Indian collectors for many years, but the rounding off of the angles as the shell becomes adult is not paralleled in the Chinese species, which is much larger, and has a reddish dull surface, like pale terra-cotta. (*Dall*).

It is probable that this species was described three times before the publication of Dall's description, but some doubt attaches to the identity in each case. We therefore retain the name *gouldii*.

The following is probably a young specimen of *D. gouldii* Dall, which is known to occur at Galveston.

D. texasianum Phil. Shell little curved, slowly increasing in diameter, white, six-angular; interstices of the ribs flat, plain at the apex, but toward the base with 1, 2 or 3 elevated striæ. Length 10 lines, diam. of base scarcely 1, of apex $\frac{3}{5}$. (*Phil.*).

Galveston, Texas (Roemer).

D. texasianum PHIL., Zeitschr. f. Malak., 1848, p. 144 (March, 1849).

Readily distinguished from other six-angled species by the size, the rate of increase, and the interstices of the ribs becoming flat toward the aperture and delicately striate there (*Phil.*).

D. americanum Chenu. (Pl. 5, figs. 71, 72). Shell with six principal projecting ribs, with weak intermediate ribs or none; transverse striæ distant.

Length 23, diam. 1·8 mill. (from fig.).

Length 28, diam. 2·8 mill. (from fig.).

Shores of America (Chenu).

D. americanum CHENU, Illustr. Conch., i, p. 1, pl. 4, f. 9, 10.

Chenu's description and figures are here given for what they may be worth. We had thought to identify *americanum* with *disparile* Orb., but in view of the strongly 6-angled section of the former, this is hardly possible. If the locality is correct we are disposed to consider it the same as *D. gouldii* Dall.

D. PICTETI Deshayes, n. sp. Pl. 11, fig. 87.

Shell narrowly elongate, slightly arcuate; white, translucid, regularly 6-angulate, the angles projecting, equal and equally spaced, very narrow; the interstices smooth, alternately marked with translucent and opaque-white. Aperture symmetrical, six-angled; peristome thin, transverse. Posterior orifice small, circular, somewhat bi-labiate.

West Indies? (coll. Delessert).

D. americanum var. *c*, CHENU, Illustr. Conch., pl. 6, f. 35 (not pl. 4, f. 9, 10).—*D. picteti* DESHAYES in MS. card catalogue of *Dentalium*.

Deshayes, from whose MS. the above diagnosis is taken, states that Chenu lumps two if not three species under the name *D. americanum*. The present form seems to be distinct from *D. disparile* in the six continuous prominent ribs with no interstitial riblets, and in

the apical contraction, reminding one somewhat of *D. sectum, calamus*, etc. We have seen no specimens.

D. INTERCALATUM Gould. Pl. 11, figs. 88, 89.

Shell strongly curved and conspicuously tapering in its earlier half, the later half nearly straight and less tapering; white, lusterless. *At and near the apex hexagonal in section,* the angles rather sharp and a little projecting, intervals nearly flat. *Not far from the apex a secondary riblet arises in each of the two faces on the outer curve, and somewhat later the lateral faces and those on the concave side are similarly divided;* the secondary riblets gaining rapidly in strength, and on the latter part of the shell equal to the six primary ribs. *Toward the aperture there are 12 equal, equidistant ribs,* rounded but well projecting, and about half as wide as the concave, excavated intervals, which are smooth except for light growth striæ. Aperture circular, the outer edge of peristome scalloped by the ribs. Apical orifice circular, about half as wide as the truncated apex. Length 19, diam. at aperture 2·25, at apex 0·9 mill.

China Seas (North Pacif. Expl. Exped.).

D. intercalatum GOULD, Proc. Bost. Soc. N. H., vii, p. 166 (1859); Otia, p. 119.—SOWERBY in Conch Icon., xviii, pl. 7, f. 45 (1872).

In *D. hexagonum* the secondary riblets when developed do not arise so soon, and the six primary angles are stronger. Figure and description from the type in U. S. National Museum, No. 24183.

Sowerby's figure copied on plate 6, fig. 85, is not characteristic, from its much greater proportionate diameter.

D. PSEUDOSEXAGONUM Deshayes. Pl. 4, figs. 47, 48.

Shell cylindrical, subulate, somewhat curved, grayish-white, somewhat transparent. At the apex there are 6 strongly projecting equidistant angles; between each of these ribs a great many striæ arise, covering the shell, and the primary ribs rapidly decrease and disappear at the first fourth or third of the shell's length. Growth striæ quite fine and often regular. Length 45–50, greatest diameter 4 mill. (*from Desh.*).

Masbate, Philippines; W. Colombia (Sowb.); *Cape York, near Albany I., N. Australia,* 11 fms.; *Darnley I., Torres Straits,* 30 fms. (Chevert Exp.).

D. pseudosexagonum DESH., Monogr. *Dent.*, Mém. Soc. Hist. Nat. Paris, ii, p. 358, pl. 16, f. 14, 15, 16 (1825).—SOWB., Thes. Conch.,

iii, p. 103, pl. 224, f. 34 (1860); Conch. Icon., xviii, pl. 4, f. 23 (1872).—Brazier, Proc. Linn. Soc. N. S. Wales, ii, p. 56 (1877).

Brazier writes: This species is six-ribbed near the apex, finely striated below, as Mr. Sowerby expresses it. The specimens before me have very fine, thread-like ribs; the number of ribs in all are from 24 to 25, and at or near the apex 6. Shell thin, white, slightly arched.

There can be no reasonable doubt that "W. Columbia" cited by Sowerby as a locality for this species, refers to specimens of *D. oerstedii* Mörch. We have unfortunately no Oriental examples for comparison with the West American species, and published descriptions are insufficient; but while the forms from opposite sides of the Pacific may be identical, it is at least unlikely that they are. Deshayes was ignorant of the locality of his species, but he was well supplied with East Indian material and had very little from the Panamic Province, so it is somewhat likely that his types were from the former region. Fig. 47 is a copy of Deshayes original figure.

D. oerstedii Mörch. Pl. 10, figs. 60, 61, 62, 63, 64.

Shell not much curved, decidedly tapering, rather solid, white. Sculpture: *hexagonal at and near the apex*, with a narrow, raised riblet at each angle, the intervals flat; a short distance from apex each face is divided by a riblet which soon attains the size of the six primary ribs, and the tube becomes circular in section. Somewhat further on, each interval on the convex and lateral faces of the shell bears a (tertiary) riblet, and still later these appear in the intervals on the concave side, so that the number of riblets at the middle of the shell is 12 (usually with some small threads also), and at the aperture it varies from 21 (or sometimes as few as 17) to 24, according to the age, and individual variation in development of tertiary riblets on the concave face. Near the aperture the riblets become rather low and wide, and are somewhat unequal. Growth striæ fine and inconspicuous, but occasionally there are low, varici-form rings on most specimens.

Aperture slightly oblique, circular; apex small, with circular orifice without slit or notch of any kind.

Length 39·5, diam. of aperture 3·5, of apex 1 mill.

Length 37, diam. of aperture 3·2, of apex 0·9 mill.

Bay of Panama, 26 and 30 fms., very abundant; *Galapagos Is.*, in 812 fms.; *off Guaymas*, 20 fms. (U. S. F. Commission); *Gulf of Nicoya* (Oersted); *also Guaymas* (Dall), apparently on the shore.

D. oerstedii MORCH, Malak. Blätter, vii, p. 177 (1861).

The hexagonal six-ribbed apex, with interstitial secondary and tertiary riblets successively appearing in the intervals, are the more obvious features of this form. The specimens from Panama Bay and Galapagos Islands are lusterless and somewhat chalky. This southern race is evidently the typical *D. oerstedi* which was described from a rather short specimen. A translation of Mörch's diagnosis is as follows:

D. oerstedii Mörch. Shell arcuate, rather solid, somewhat shining, white or yellowish, hexagonal at apex. Aperture circular, having 12 liræ, the interstices smooth posteriorly, but toward the middle divided by a riblet, whence to the aperture there are 24 liræ. Growth lines here and there more raised, nearly variciform. Length 27, diam. 3 mill.

Gulf of Nicoya, west coast of Costa Rica (Dr. A. S. Oersted).

A specimen in the U. S. National Museum (no. 18,711) from Rio Janeiro (U. S. Expl. Exped.) considerably resembles this species.

Var. NUMEROSUM Dall, n. var. Pl. 10, figs. 70, 71, 72, 73.

This name, which Dall used to cover the entire species, as found from Lower California to the Galapagos, may be utilized in a restricted sense for the northern form.

The general proportions and curvature are as in typical *D. oerstedi*, but the sculpture is less coarse; tertiary riblets soon appear on the concave as well as the other sides of tube, and toward the middle a varying number of threads of a fourth order are interposed; toward the aperture all sculpture becomes flattened, and the total number of riblets and threads is decidedly greater than in typical *oerstedi*. The primitive 6 riblets retain their predominance longer than in the type. The specimens are glossy. Length 41·5, diam. of aperture 3·5, of apex 0·6 mill.

Types of var. *numerosum* are no. 87,559, U. S, Nat. Mus.

Off Lower California, near Cerros Id., lat. 28° 12′, long. 115° 9′ in 44 fms., *and 24° 18′, 110° 22′*, in 26 fms.; *off Todos Santos, lat. 23° 33′, long. 110° 37′*, in 66 fms. (U. S. Fish Commission).

Group of D. agassizi.

Forms resembling the *D. octangulatum* group in general appearance, but with more numerous riblets.

Key to Species.

a. 11–20 sharp riblets separated by deeply concave intervals, increasing to 24–48 riblets at aperture; slender, *agassizi, majorinum.*

a'. About 14 slightly elevated, but well defined riblets; very narrow, acuminate; length 31, diam. 1·6 mill., *cookei*, p. 29.

a''. 20–25 very delicate, equal liræ; small, moderately slender; length 31, diam. 2·7 mill. *usitatum*, p. 29.

a'''. 17–21 narrow, separated riblets, increasing to about 25 at aperture; conspicuously transversely striated; large and stout; length 75–78, diam. 10–11 mill., *shoplandi*, p. 28.

D. agassizi Pilsbry & Sharp, n. sp. Pl. 12, figs. 90, 91, 92, 93, 94.

Shell gently curved posteriorly, the later half nearly straight, tapering, solid, white and lusterless (often with a black encrustation toward the apex, and reddish-brown on the larger end). Sculpture: at the apex there are 12–20 rather sharp and well raised riblets separated by wider, concave intervals; at a varying distance from the apex an interstitial thread appears in these intervals, so that near the middle of the shell's length there are double that number of riblets and threads, alternately larger and smaller, and at the aperture there are 25–48 unequal riblets and threads, lower and blunter in large examples. Aperture somewhat oblique, subcircular, but the arc along the concave side is sometimes less curved than the remainder of the peristome, and the edge is irregular from breakage. Anal orifice small, circular, no slit or notch, but often the inner layer projects tube-like from erosion of the softer, more chalky outer layer.

a. Length 65, diam. at aperture, 4·3, at apex 0·7 mill. (type).

b. Length 31·7, diam. at aperture 3·2, at apex 1 mill.

c. Length 30·7, diam. at aperture 3, at apex 0·7 mill.

d. Length 29, diam. at aperture 3·1, at apex 0·7 mill.

Gulf of Panama, 322 to 1020 fms.; *off Acapulco*, 660 fms.; *Santa Barbara Is., California*, 414 fms.; *off San Diego, California*, 822 fms. (U. S. Fish Commission).

D. pretiosum var. *indianorum* is far less coarsely sculptured than this species, and the ribs do not crenulate the peristome. *D. occidentale* is very similar, but the sculpture developed between the primary ribs is unlike this Pacific form. *D. majorinum* and its variety *magellanicum* are also much like *agassizi*, but the latter has finer sculpture. The inner layer of shell substance is very dense and bluish-white, the outer layer being softer and more chalky, frequently eroded, often exposing the inside stratum which resists the solvent power, at the apex and elsewhere.

The number of riblets is quite variable; thus the four specimens measured above have:

(*a*) At apex 20, at aperture 48 riblets.
(*b*) At apex 17, at aperture 40 riblets.
(*c*) At apex 14, at aperture 29 riblets.
(*d*) At apex 12, at aperture 25 riblets. (Off San Diego).

The number of interposed riblets varies somewhat, but the number of apparently primary ribs at the apex is also subject to a wider range of variation than usual.

D. MAJORINUM Mabille & Rochebrune. Pl. 12, figs. 98, 99.

Shell moderately curved posteriorly, the later two-thirds nearly straight, slender, attenuated toward the apex; white, the young and newer growth of adults somewhat translucent; slightly shining. Sculpture of about 11 narrow, rather acute ribs near the apex, separated by concave intervals; the number increasing by intercalation to about 29 at the aperture, where they are approximately equal, with concave, transversely finely striate interstices, in some of which a median riblet occurs. Aperture circular, not oblique. Anal orifice minute and circular, without slit or notch. Length 38·5, diam. of aperture 3·5, of apex 0·7 mill.

West coast of Patagonia, 122 fms. (U. S. F. C. sta. 2783); *Orange Bay, Patagonia* (M. & R.).

D. majorinum MAB. & ROCH., Miss. Sci. Cap Horn, vi, Zool., Moll., p. 100, pl. 4, fig. 10 (1889).

Something is wrong with Mabille and Rochebrune's measurements (their figure measuring, length 50, diam. at aperture 4·3 mill.), and their description is not very good. It is here translated.

Shell long-conic, rather slowly increasing, much attenuated toward the apex, hardly shining, subpellucid, a little fragile, ornamented with numerous, nearly equidistant, somewhat roughened

[*scabriusculis*] ribs; the intervals concave, sculptured with very minute transverse ribs. Apex entire, minute, somewhat campanulate. Length 0·74, diam. 12 mill. (*M. & R.*).

Orange Bay, Patagonia.

Another form of this species was collected by the U. S. Fish Commission at Sta. 2777 and 2780 in 77½–369 fms., bottom temp. 36°–46° Straits of Magellan. It has the riblets on the median portion of the shell unequal, alternating, becoming subequal toward the aperture where they are rounded and parted by narrow grooves, instead of acute, with wider concave intervals as in the type. Length 57, diam. 4·5 mill. This form may be called var. MAGELLANICUM (pl. 12, figs. 95, 96, 97). In the specimen figured there are 12 or 13 riblets at apex, 24 at aperture. Type no. 87561 U. S. Nat. Museum.

D. SHOPLANDI Jousseaume. Pl. 12, fig. 100.

Shell large, but slightly curved, nearly straight, solid, slowly tapering; cream-white with gray-white ribs. Sculpture: *near the apex 17 subequal but unequally spaced, narrow, sharply defined riblets* very much narrower than the interspaces; *these continue to the aperture, increasing in size;* their number is early *increased by the intercalation of some interstitial threads,* mainly on the concave side, so that at the aperture there are 25 unequal, unevenly spaced ribs and threads; *the whole surface densely and conspicuously striated transversely,* the striæ unequal, like cords scattered among threads, crenulating the riblets. Aperture oblique, subcircular, a trifle wider than long, the peristome jagged from fracture. Apex large, the orifice simply circular, without notch or slit.

Length 78·5, diam. at aperture 10, at apex 3·2 mill.

50 miles off Aden, in 678 fms.

D. shoplandi JOUSS., Bull. Soc. Philomath. de Paris (8), vi, p. 102 (1894).

A large species, apparently without near allies. It is remarkable for the prominence of the growth-striæ, and the clearly carved ribs of the surface.

Figure and description are from a specimen in coll. U. S. National Museum. Jousseaume's original diagnosis is as follows:

Shell large, gray-white, cylindrical, slightly arcuate, longitudinally costate, transversely densely lamellose-striate; ribs 21, subequal, separated by flat grooves. Length 75, diam. 11 mill.

D. COOKEI Sharp & Pilsbry, n. n. *Unfigured.*

Shell thin, very narrow, acuminate, polished, subpellucid, little arcuate; fluted with about 14 ribs, which are not equidistant, only slightly elevated, but distinctly defined at their bases; ribs at the apex coalescent and vanishing; interstices shallow and polished. Length 1·25, diam. at base 0·0625 inch. (*Cooke*).

Gulf of Suez (MacAndrew).

D. acus COOKE, Ann. Mag. N. H. (5), xvi, p. 274 (Oct., 1885). Not *D. acus* Eichwald, 1856.

Probably a young shell, but very distinct from any known species. It is a most graceful shell, exquisitively marked and polished. One specimen. (*Cooke*).

D. USITATUM E. A. Smith. Pl. 10, figs. 68, 69.

Shell small, moderately slender, white, little arcuate; having about 20–25 very delicate, equal longitudinal liræ, sculptured with oblique lines of growth. Scarcely slit at the apex. Length 31, greatest diam. 2·7 mill. (*Smith*).

Off Colombo, Ceylon, lat. 6° 32′ N., long. 79° 37′ E. in 675 fms.; *Bay of Bengal* in 597 fms. (Investigator).

D. usitatum SMITH, Ann. and Mag. N. H. (6), xiv, p. 168, pl. 4, f. 16, 16*a* (Sept., 1894).

The two specimens examined do not look as if they were young shells. The white color is varied here and there with narrow, oblique, somewhat pellucid zones. (*Smith*).

GROUP OF D. CARDUUS.

Shell longitudinally ribbed, latticed by circular riblets or fine raised lamellæ, often rising into minute knots or spines at the intersections.

The species following would apparently fall into Sacco's subgenus *Coccodentalium* (Boll. Mus. Zool. ed Anat. Comp. R. Univ. di Torino, xi, 1896, p. 98). We have not seen *D. radula* Schröter, Gmel., the type of that group, and Sacco gives no diagnosis, but the description of that Pliocene species indicates sculpture like *carduus*. Other members of the same section are *D. tryoni* Pils. & Sharp of the Miocene of San Domingo, and possibly the recent *D. cancellatum* Sowb.

The group *Coccodentalium* is hardly equivalent in value to the subgenera we have recognized, being merely a modification of the *D. agassizi* type.

D. CARDUUS Dall. Pl. 7, fig. 6.

Shell pure white, sometimes attaining an ashy or rusty tinge from extraneous matter, elongated, slightly curved, and *with a rasp-like surface* for about half its adult length; longitudinal sculpture of very numerous fine sharp raised threads with somewhat wider interspaces, in which intercalary threads from time to time arise; *transverse sculpture of fine sharp elevated lamellæ which cross the threads and become almost spinulose on the intersections;* these can be felt, but are almost too fine to be clearly seen with the naked eye; in the perfectly adult shell, this sculpture becomes, through senility or wear, less sharp on the last half of the shell; though both sorts of ridges persist, they are thicker and more rounded; shell not very thick; aperture circular, very little oblique; anal orifice small, with a short wide slit on the convex side, and no notch or wave on the other. Length of completely adult shell, 87·0; height of arch from chord, 7·0; diameter of aperture, 7·0; of anal orifice 0·7 mill. (*Dall*).

Near Santa Lucia, in 116 fms.; in 154 fms., ooze, *near Granada* (Blake). Also by U. S. Fish Commission, in 338 fms., *on the Little Bahama Bank.*

D. carduus DALL, Blake Rep., Bull. M. C. Z., xviii, p. 423, pl. 27, f. 3 (1889); Bull. U. S. Nat. Mus., no. 37, p. 76, pl. 27, f. 3.

The specimen figured is only 16 mill. long, but shows sufficiently the characters of the form and sculpture. Better specimens were afterwards found in some of the Fish Commission dredgings, from which the above description is drawn. The peculiar sharpness felt by drawing the shell gently between the finger and thumb is very recognizable and under the glass the sculpture is very beautiful. (*Dall*).

A closely allied species attains a very large size in the Oligocene of San Domingo.

D. CANCELLATUM Sowerby. Pl. 10, fig. 67.

Shell thin, white, acuminate, strongly curved towards the apex, where it is cancellated by *about 8 longitudinal ribs* and *elevated concentric striæ*, then the shell becoming straighter and the ribs more numerous (*Sowb.*). Length 25½, greatest diam. 3 mill. (from fig.).

China (Sowb.).

D. cancellatum Sowb. Jun., Thes. Conch., iii, p. 101, pl. 224, f. 36 (1860); and in Conch. Icon., xviii, pl. 5, f. 29.

Cancellated near the apical end by distinctly raised striæ crossing the longitudinal ribs (*Sowb.*).

Group of D. quadrapicale.

Small or moderate sized shells with *the tube square at and near the apex*, having angles on the convex, concave and two lateral sides, *becoming subcircular at the aperture.* Generally costulate between the angles, sometimes smooth; the apical orifice occupying a short pipe, or without this and square or round.

Distribution, Pacific shores of tropical and subtropical America, and of the East Indies south to Torres Strait.

No species of this very distinct group appear in the "Albatross" dredgings off west America, so it is likely that the species are shallow water forms, not descending to archibenthal or benthal depths.

No recent species is yet known with certainty from the Atlantic or Gulf of Mexico; but in the Miocene of Jamaica and San Domingo *D. dissimile* Guppy and its probable synonym, *D. ponderosum* Gabb, species allied to *D. dipsyche*, but much larger and more solid, occur. Dall has described from the Caloosahatchie Pliocene a *D. caloosaënse*, also similar in general characters, and doubtless the direct descendant of the Miocene species. Another similar form has been reported by Harris from the "Galveston deep well" as *D. quadrangulare?* Sby., from strata of upper Miocene age. The fragments seen by us are not large enough to be characteristic, but it is probably not the recent species. In the same deposit occurs a form not separable so far as material we have seen shows, from the recent *D. tesseragonum* (*D. tetragonum* Sby., Harris, Bull. Amer. Paleont., no. 3, p. 13).

Nothing we have seen from the Eocene belongs to this immediate group.

Key to Species.

I. The four primary ribs bifid or trifid; shell attenuated and striated toward apex, smooth toward aperture. Length about 30 mill., *dispar*, p. 32.

II. Primary ribs serrate, intervals ribless; aperture angular, *quadricostatum*, p. 33.

III. Primary ribs not split or serrate.

a. Surface smooth; length 20 mill., *tesseragonum*, p. 34.

a'. Surface costulate,

b. Decidedly attenuated toward the apex; aperture somewhat compressed vertically,

32 riblets at aperture, which is hardly oblique; length 45 mill., about 11 times greatest diam., *dipsycha*, p. 33.

36 riblets at aperture, which is very oblique; length 20 mill., about 6 or 7 times greatest diam., *quadrapicale*, p. 34.

b'. Not much tapering, the apex large; aperture circular.

Length 14 mill., about 8 times the greatest diam., *fisheri*, p. 36.

Length 20 mill., about 5½ times the greatest diam., *quadrangulare*, p. 35.

D. quadricostatum Braz., perhaps belonging to this group, is not clearly enough described to admit of its inclusion in the above analysis without doubt. Whether the keels are serrate (as in the fossil *D. radula*), or divided as in *D. dispar*, we do not know.

D. DISPAR Sowerby. Pl. 4, figs. 52, 53, 54, 55, 56.

Shell rather slender, the length about 9 times the greatest diameter in adults; earlier third well curved, the rest of the length but slightly arcuate; much attenuated toward the fine apex; rather thin, white or bluish-white, glossy and brilliant. Sculpture: *four-angled at apex (square in section)*, the angles dorsal, ventral and lateral, continuing as keels which rapidly become obsolete (extending two-thirds the length of shell in a specimen 15 mill. long, but only about one-third the length in one 30 mill. in length); each of the *four primary ribs bifid or trifid* at summit. Between these angles, throughout their extent, the surface has very fine longitudinal riblets; and not far from the apex a secondary rib arises in each of the four faces, and continues as far as the primary ribs. *The larger moiety of the shell is polished, cylindrical, wholly free from longitudinal sculpture.* Growth striæ fine and inconspicuous.

Aperture slightly oblique, sub-circular, the peristome thin; anal orifice square with thin walls, and without slit or notch. Length 30, antero-posterior diam. of aperture 3 mill., lateral 3·2 mill.

Singapore (Sowerby, S. Archer); *Samar, Philippines* (Sowb.); *China Sea* (A. N. S. P.); *Darnley I., Torres Straits,* 30 fms. (Chevert Exp.).

D. dispar Sowb., Thes. Conch., iii, p. 103, pl. 224, f. 37 (1860); and in Conch. Icon., xviii, pl. 4, f. 25 (1872).—Brazier, Proc. Linn. Soc. N. S. Wales, ii, p. 58 (1877).

Young shells taper more rapidly, as usual, and of course a greater part of their length is sculptured. The summits of the four primary ribs are subdivided by one or two longitudinal grooves in this species, but are simple in *D. quadrapicale* and *D. quadrangulare.*

D. quadricostatum Brazier.

Shell white, very slightly arched, four angled, keel or rib at each angle, rounded, finely serrated, interstices flat, marked with transverse lines; apex perforated, perforation entire; aperture angled. Length, 8 lines; diam. of base, 1 line [16, 2 mill.]. (*Brazier*).

Princess Charlotte Bay, north-east Australia, 13 fathoms; *York Island, Torres Straits,* 13 fathoms, hard mud; *Katow, New Guinea,* 8 fathoms, sandy mud. (*Chevert Exped.*).

D. quadricostatum Braz., P. L. S., N. S. W., ii, p. 58 (1877).

If this species is laid upon its side it forms a true square; when resting with the arched part of the apex down, it forms four angles, with a serrated rib on each angle. The 11 specimens from Katow, 16 from Princess Charlotte Bay, and 1 from York Island, all have the same character. (*Brazier*).

D. dipsycha Pilsbry & Sharp, n. sp. Pl. 4, figs. 57, 58, 59, 60.

Shell slender, the length about 11 times the diam., well curved, attenuated toward the apex; white, nearly lusterless. Sculpture: *at and near the apex square in section,* with four acute, narrow, projecting, longitudinal, pinched-up ribs, the spaces between flat; not far from the apex in each face a median thread arises, and soon equals the primary four in size; each interval then bears a tertiary thread, and here the section of the tube has become *circular.* At about the middle of the length another set of interstitial threads appear; so that *at the aperture there are 32 flat, equal, low, but abruptly defined riblets* separated by flat interstices of about the same or slightly greater width. Interstices everywhere plain except for circular growth-lines, which are moderately obvious throughout.

Aperture rounded, somewhat compressed antero-posteriorly, the inner margin less curved; hardly oblique; peristome thin. Anal orifice circular, occupying a very short tube. No slit. Length 45, antero-posterior diam. of aperture 3·8, lateral diam. 4·1 mill.

Habitat unknown.

This species differs from *D. dispar* in the simple primary ribs, lack of fine, even longitudinal striation, and persistance of the sculpture to the aperture. *D. quadrapicale* is allied, but has a much more oblique aperture, more rapidly tapering tube, and though far smaller, a greater number of much finer longitudinal riblets.

D. QUADRAPICALE ' Hanley ' Sowerby. Pl. 4, fig. 50.

Shell rather stout, apical third strongly curved, the remainder but slightly arcuate; white, shining. Sculpture, *four angles at the apex* (giving that part an *almost square section*, the two outer sides of the square slightly longer), situated at the outer, inner and lateral surfaces, the faces between them straight and flat; these angles rapidly lose in prominence, and the intervals become convex; very near the apex each interval becomes parted by a secondary riblet; and the interstices between these are again divided by tertiary threads at about the end of the first third of the shells length; and subdivision proceeds until *at the aperture there are about 36 low, subequal riblets*, with narrow, shallow intervals, *and the tube is subcircular, a little flattened antero-posteriorly, in section.* Growth-striæ faint. *Aperture very oblique.* Anal orifice without slit or notch.

Length 20, length of aperture, measured obliquely 3¼, breadth 3 mill.

Length 31·5 mill (original figure).

Cochin; Malabar (Hanley coll.).

D. quadrapicale Hanley *MS.*, SOWERBY, Thes. Conch., iii, p. 103, pl. 225, f. 61 (1860); and in Conch. Icon., pl. 7, f. 46.—*D. quadripicale* CLESSIN, Conch. Cab., p. 13.

The square apex and rounded, oblique aperture are strong points of difference from most known species. Sowerby's figure shows the anal orifice minute and round; but in the single specimen we have seen it is large and square, the shell walls thin.

D. TESSERAGONUM Sowerby. Pl. 4, fig. 51.

Shell moderately arcuate, tapering, attenuated toward the apex, rather thin, white. At the *apex square*, with four equal faces, the

angles pinched up into narrow ribs, which continue to or beyond the middle of the shell, gradually decreasing; intervals at first flat or somewhat concave, soon becoming convex midway between the ribs, and when perfectly preserved showing faint longitudinal striation at this place; the convexity increases until *the latter third of the shell is cylindrical, and sculptured with rather conspicuous, oblique growth-lines only.* Aperture oblique, circular. Apex minute, with a circular orifice; no slit or notch. Length 30·5, diam. at aperture 2·9, at apex 0·6 mill.

Gulf of Nicoya and Puerto Portrero, W. coast Central America; also *Xipixapi, west coast Colombia* (Cuming), 10–16 fms., sandy mud.

D. tesseragonum G. B. Sowerby, P. Z. S., 1832, p. 29.—*D. tetragonum* Sowb. Jr., Thes. Conch., iii, p. 103, pl. 224, f. 21, 22 (1860); and in Conch. Icon., xviii, pl. 4, f. 20*a*, *b*.—? Carpenter, Rep. Brit. Asso. Adv. Sci. for 1863, p. 666; Moll. West Coast N. A., p. 152. Not *D. tetragonum* Brocchi, 1814.

The original description here follows: Shell thin, milk-white, smooth, at first tetragonal but becoming cylindrical by the disappearance of the angles; very delicate growth-lines forming subhyaline rings. Length 0·8, diam. 0·1 inch. (*G. B. S.*).

Var.: angles indistinct; growth-lines forming rings (*G. B. S.*).

Mr. Sowerby changed the name of his fathers species in 1860 without assigning any cause, or even mentioning that a change had been made. The etymology of the original name is obvious, and we do not see that such radical emendation is called for, the more because the specific name *tetragonum* had already been used by Brocchi.

Carpenter reports *tetragonum* Sby. from Margarita Bay, Pacific coast of Lower California in about N. lat. 24°, specimens collected by one of Harper Pease's collectors. They may possibly be referable to *D. fisheri, q. v.* There are some specimens in the collection of the Academy said to be from Rio Janeiro, collected by the U. S. Exploring Expedition. We do not know whether the locality is authentic or not, but it seems doubtful. There were, however, several species of this type in the Antillean Miocene fauna.

D. QUADRANGULARE Sowerby. Pl. 5, fig. 77.

Shell small, white, quadrangular, the angles rather acute, interstices striated. Aperture four-cornered. Length ·8, diam. ·15 inch.

[=20, 3·75 mill.]. The color of this shell is variable, being either milk-white, yellowish or reddish; the angles are less acute at the larger end; and at the smaller end there is sometimes formed a tubular appendage. (*G. B. S.*).

Xipixapi, West coast of Colombia (Cuming); *Realejo, west coast of Nicaragua* (Dr. A. S. Oersted).

D. quadrangulare G. B. Sowerby, Proc. Zool. Soc. Lond., 1832, p. 29.—Sowb. Jr., Thes. Conch., iii, p. 103, pl. 224, f. 31; and in Conch. Icon., pl. 5, f. 27.—Morch, Malak. Blätter, vii, p. 176 (1861).

White, small, striated, cylindrical, four-sided at the apical end, rounded at the other (*Sowb.*). The single specimen collected by Dr. Oersted measures, length 6½, diam. 1⅛ mill.

D. fisheri Stearns, n. sp. Pl. 5, figs. 61, 62, 63, 64, 65.

Shell *cylindrical* becoming *square toward the apex, not much tapering*, and nearly as wide at apex as at aperture; moderately arcuate; comparatively solid and strong. White with the riblets gray; lusterless. Sculpture of four strong angles *at and near the apex, where it is square;* these angles rapidly decreasing in prominence until at the first third of the shell's length the section is almost round. Very near the apex each of the four faces is parted by a median riblet; and a little further on a tertiary series of riblets, one in each of the intervals except the two bounding the keel of the convex side, in which intervals small riblets develop later. At the middle of the shell's length the section is circular and the 28 to 30 riblets nearly equal in size; a few threads are intercalated toward the aperture, where the riblets are slightly unequal, low, narrow and close. Aperture circular, slightly oblique. Anal orifice circular, with a slightly raised rim; placed in the middle of the square apex. Length 14·1, diam. at aperture 1·8, at apex 1·2 mill.

Los Animas Bay, Lower California (type no. 46204, U. S. Nat. Mus.).

D. fisheri Stearns, Proc. U. S. Nat. Mus., xvii, 1894, p. 157 ("provisional" name only; no description).

This species is evidently near to *D. quadrangulare* Sowb. of Colombia, but it is narrower in proportion to its breadth. We have not, however, been able to compare specimens of Sowerby's species. The general system of sculpture is the same as in several allied species;

and it must be remembered in dealing with these that an older shell, or a younger one, would show corresponding differences in the sculpture at and near the apex, owing to the truncation of this part with advancing age.

This species is probably what Carpenter reports as *D. tetragonum* Sby. from Margarita Bay.

Another specimen (no. 46207, U. S. Nat. Mus.) before us, from the Gulf of California (pl. 5, fig. 63, apex enlarged), is probably an older stage of this species, in which the apex has been more truncated, the riblets extending to the extreme end. There is a short "pipe" for the anal orifice. Length 14·7, diam. at aperture 1·8, at apex 1·3 mill.

Subgenus ANTALIS H. & A. Adams, 1854.

Entalis GRAY, P. Z. S., 1847, p. 158, type *D. entalis.* Not *Entalis* Sowerby, 1839, = *Pyrgopolon* Montf. 1810.

Antalis H. & A. AD., Gen. Rec. Moll., i, p. 457, examples *A. semistriolata* Gldg. and *A. entalis* L. (1854); from *Antale* ALDROVANDUS, De Reliquis Animalibus exanguibus, lib. iii, De Testaceis sive conchyliis, p. 282 (1642).

Entaliopsis NEWTON & HARRIS, Proc. Malac. Soc. Lond., i, p. 66 (1894), type *D. entalis.*

Shell circular or polygonal in section, sculptured with longitudinal ribs or striæ at least in the young, often without longitudinal sculpture in adults, or only so sculptured near the apex; apex generally with a v-shaped notch at or near the convex side, or with a solid plug and central short tube or orifice.

Type *D. entalis* Linn.

Distribution, Mediterranean, North Atlantic, Arctic and North Pacific. Mainly a group of moderate depths.

These forms differ from the foregoing ribbed species in the peculiarities of the apex mentioned above, which are probably developed in some specimens of all the species, though examples not showing them are also abundant in all.

The group as here constituted may seem heterogeneous, including as it does species with or without a v-shaped apical notch, with or without a short pipe or tube inserted in an apical plug, and either heavily ribbed or smooth; but apical characters vary within each species in limits so wide that they are among the secondary specific characters, and they are not correlated with sculptural characters.

Thus, were we to divide into (1) species with a tubular apical foramen and (2) those with a v-like notch, such closely allied forms as *D. vulgare* and *D. weinkauffii* would be separated, and a good many specimens of other species would fail to show the differential features; if we divide by a criterion of sculpture, each section would contain forms with various apical characters, and a number of species intermediate in sculpture.

If the characters of the apex be held of subgeneric importance, then the group with an apical tube, such as *vulgare*, *novemcostatum*, etc., will require a new subgeneric name.

The names for this division of *Dentalium* are involved in obscurity. Aldrovandus, writing in 1642, proposed to call the smooth Italian species (probably *D. vulgare*) *Antale;* but as his nomenclature was not binomial, the name has of course only a historic interest in the light of subsequent events. Defrance and other early French writers enter "*Antale*" as a synonym of *Dentalium*, or another name for *D. entalis* (see Nouv. Dict. d'Hist. Nat. ii, p. 136, 1816; Encycl. Méth., i, p. 75, 1892, etc.). Schröter, between 1774 and 1784, is said to mention *Antale*, but his two works on geology, "Lithologisches Real- und Verballexicon," and "Vollständige Einleitung in die Kenntniss und Geschichte der Steine und Versteinerungen," are not accessible to us, and it does not appear that he adopts *Antale* as a genus.

In 1846, Herrmannsen mentions *Antalis* Aldrov. as a name for smooth *Dentalia*, no type species being given.

In 1854 H. & A. Adams recognized *Antalis* Aldrov. as a second genus of *Dentaliidæ*, with the following diagnosis: "Shell symmetrical, tubular, subcylindrical, recurved; apex perforated, perforation with a notch-like fissure on the dorsal or posterior margin; aperture circular, entire. Of the two examples cited, *A. semistriolata* Guild. is evidently introduced merely as an illustration of the soft anatomy, but as the shell has no "notch-like fissure," it is apparent that the second example, *A. entalis* L., of which the shell is figured, must be the type. It agrees with the generic definition, and with the express statement in regard to the fissure following it. So far as we can learn, this was the first formal introduction of the term *Antalis* into post-Linnæan nomenclature, and although the name is attributed by Adams brothers to Aldrovandus, it is essentially a new group, the original "*Antale*" Aldrov. (*D. vulgare*= *tarentinum*) being omitted from the list given under *Antalis* Adams, and placed in *Dentalium*.

Stoliczka in 1868 restricts *Antalis* to the species of the type of *D. vulgare*, in which there is a supplemental tube at the apex, separating it generically from *Entalis* Gray. Tryon and Fischer follow Stoliczka's definition of *Antalis* or *Antale* and *Entalis*.

Finally, Newton and Harris in 1894 finding *Entalis* Gray preoccupied by Sowerby (but not by Defrance, as they allege) substitute *Entaliopsis* for the group.

It appears, therefore, that *Entalis* Gray, *Entaliopsis* Newton & Harris and *Antalis* Ads. are absolutely equivalent, being based upon the same species as type.

There is another chapter of this history, in which the genesis of "Entale" (Defrance's Gallic vernacular for *Entalium*) is dealt with, the vicissitudes of its career related, with at last its final transformation into "*Entalis*." The details of this melancholy tale may be found by the curious in the section of this volume treating of *Pyrgopolon*.

Group of D. entalis.

Shell moderately or very solid, circular in section; white or reddish toward the apex; near the apex always sculptured with longitudinal riblets or striæ, at least in the young, but frequently the greater part in adults is smooth, with growth-lines only. Apex typically with a slightly projecting "sheath" interrupted by a small v-shaped notch on or near the convex side.

North Atlantic, Mediterranean and North Pacific in distribution, from shallow water to the greatest depths reached.

In many species of this group the inner layer of the shell is of more porcellanous, firmer texture than the outer, and by the progressive erosion of the smaller end with growth this layer projects slightly as a sort of narrow, elevated rim around the apical orifice, interrupted on one side by the notch, as shown in fig. 25 of plate 8. This condition, while usual in some species and likely to occur in all of the group, is by no means invariable in any of them. In some forms the inner layer thus exposed by erosion, may form a longer tube, as in the young specimen of *D. agile* which Jeffreys called *D. vagina*. The same structure occurs in *D. agassizi* and many other forms. This tube is not homologous with the apical tube of *D. vulgare* (which is probably more allied to the *novemcostatum* group), or of *D. filum*, etc.

Key to species.

I. Shell becoming round and nearly smooth toward aperture, sharply and finely striate longitudinally toward apex, at least in the young.

a. Very fine longitudinal striæ throughout, sharp threads on on smaller end.

b. No apical notch, the orifice simple or tubular, *vulgare*, p. 41.

b'. An apical notch; more than half the length sharply striate, *weinkauffii*, p. 40.

a'. Only circular striæ on larger part of the shell; apex with a short sheath and v-like notch, or simple, *entalis*, p. 42; *pretiosum*, p. 44; *agile*, p. 46.

II. Shell with numerous riblets toward apex, persistent or becoming obsolete near aperture.

a. About 12 riblets at apex, becoming lower and double as many and sometimes obsolete near aperture, *occidentale*, p. 47.

a'. 26–28 narrow ribs throughout, no interstitial riblets or striæ, *ænigmaticum*, p. 49.

D. WEINKAUFFI Dunker. Pl. 2, fig. 26.

Shell large, solid, the smaller third well curved, the remainder slightly so; stout; the length about 11 times the diam. of aperture; apical end not much attenuated. Flesh-colored, fading to whitish toward the mouth; shining. Sculpture, *16 narrow longitudinal threads at apex, indistinctly alternating larger and smaller, and increasing to about double that number at* the end of the first third of the shell's length. These threads are most prominent at the smaller end, and gradually decrease in size, *obsolete on the larger third of the shell*, where microscopic, superficial longitudinal striæ replace them. *Growth-striæ conspicuously developed and irregular on the larger half of the tube.* Aperture circular, oblique, with thin peristome, the interior white, becoming yellow far within. Anal opening small, narrowly ovate, passing into a *small* v-*shaped notch* on the convex side.

Length 80, diam. aperture 7·3, diam. apex 2 mill. (specimen).

Length 86–87, diam. 8 mill. (*Dkr.*).

Bishiu coast, Japan (Stearns).

D. weinkauffi Dkr., Malak. Bl., xxiv, p. 68 (1877); Index Moll. Mar. Jap., p. 153, pl. 5, f. 1 (1882).

Not nearly allied to any other Oriental species, its relationship being rather with the Mediterranean *D. vulgare* DaCosta (*tarentinum* Lam.) and the West American *D. pretiosum* Nutt. The longitudinal sculpture does not stop abruptly, as shown in the figure, but gradually decreases.

D. VULGARE DaCosta. Pl. 8, figs. 22, 23, 24; pl. 9, figs. 53, 54.

Shell moderately curved, solid, nearly lusterless, opaque white, often with some indistinct dusky zones, and tinted with yellowish-brown or rose toward the apex. Sculpture of fine close longitudinal striæ, about 30 in number at the apex of an adult, half that many in a younger shell, increasing by intercalation to double that number of much less conspicuous, fine, low striæ on the larger part of the shell, persisting to the aperture, although weak there. Aperture circular, oblique, the peristome thin and jagged from fracture. Apex truncated in adults; anal orifice small, round or ovate, occupying a very short tube arising from the middle of the thick apical plug. "No notch, groove slit or channel."

Length 38, diam. of aperture 4·7, of apex 2 mill. (adult).

Length 36, diam. of aperture 4·6, of apex 0·5 mill. (younger).

Length 34, diam. of aperture 4·8, of apex 1 mill.

Length 48, diam. of aperture 5·5 mill.

Mediterranean and Adriatic Seas; Atlantic from Spain to Belgium; southern England and Ireland. Low water mark to 543 fms. *Miocene of Belgium; Pliocene of Italy.*

Dentale vulgare DaCosta, Brit. Conch., p. 24, pl. 2, f. 10 (1778) —*Dentalium vulgare* Monterosato, Not. int. alle Conch. Medit., p. 28 (1872).—Buquoy, Dautz. & Dollf., Moll. Mar. du Roussillon, i, p. 558, pl. 66, f. 1–6.—Dautz., Mém. Soc. Zool. France, viii, p. 370; ibid., iv, p. 609.—*D. entalis* of Olivi, Payraudeau, von Salis, Philippi and others, and in part of Linne.—*D. tarentinum* Lamarck, An. s. Vert., v, p. 345 (1818).—Forbes & Hanley, Hist. Brit. Moll., ii, p. 451, pl. 57, f. 12 (1853).—Sowb., Illustr. Ind. Br. Sh., pl. 10, f. 27; Thes. Conch., iii, p. 100, pl. 224, f. 19, 20.—Jeffreys, Brit. Conch., iii, p. 195; v, p. 197, pl. 55, f. 2; P. Z. S. Lond., 1882, p. 657.—Clessin, Conchyl. Cab., p. 3, pl. 1, f. 1, and of many other authors.—*D. striatum* Montagu, Test. Brit. ii, p. 492 (not of Born).—*D. labiatum* Turton, Conch. Dict. Br. Sh., p. 38.—

Brown, Illustr. Conch. G. Brit., p. 117, pl. 56, f. 4, 5.—*D. politum* De Blainv., Dict. Sci. Nat., xiii, p. 70 (1819).—and again Turton, ibid., p. 38 (not of Linn.), changed to *D. lœve* Turton, ibid., p. 256. —*D. striolatum* Risso, Hist. Nat. Eur. Mérid., iv, p. 398 (1826).—*D. multistriatum* Risso, ibid., p. 398 (not of Desh.).—*D. affine* Biondi, Atti dell'Accad. Gioenia di Sci. Nat. (2), xiv, p. 120, pl., f. 7 (1859).—*D. fasciatum* Gmel., Syst. Nat. (13), p. 3737.—? *D. nebulosum* Gmel., ibid., p. 3738.

Allied to *D. entalis* L., but when unworn it is lusterless, finely striated throughout, not slit or notched posteriorly, and it is more robust. The following forms have received varietal names: *elongata* Monts., *attenuata* Monts., *decurtata* Monts., *albina* Monts. (uniform white), *citrina* Monts. (lemon yellow throughout), *rosea* B. D. & D. (rose-carmine throughout). Sacco has a fossil "variety" *perstriolata.*

D. weinkauffi Dkr., of Japan, is a near relative of this species, but that has the apical notch of typical *Antalis*, while *vulgare* is like *novemcostatum* in apical features.

According to Jeffreys, "The stomach of this *Dentalium* is a repertory of littoral Foraminifera. It is not, like Spatangus or Synapta, an indiscriminate swallower of sand, but a fastidious Pig from the herd of Epicurus, luxuriously picking out the choicest morsels with its extensile and delicate captacula. Adriatic specimens of the shell collected by Professor Stossich are 2¼ inches in length and very fine."

Besides the literature cited above, there are very many references in local and faunal works, and a number doubtfully applying to this species or confusing it with *D. entalis.* Martini, Bonanni, d'Argentville and other early writers have also noticed and figured it.

D. entalis Linné. Pl. 8, figs. 25.

Shell tapering, not much curved, often irregularly divided into segments by the successive accretions of growth; it is solid, opaque, and glossy; sculpture, slight concentric lines of growth, and occasionally a few indistinct and extremely fine longitudinal striæ towards the narrower end, these striæ, when they occur, are not very numerous, and are only visible with the aid of a magnifier; *color* ivory-white, with sometimes an ochreous stain on the narrower part, caused by an admixture of mud with the sand in which this species burrows: *margin* at the anterior or broader end more or less

jagged, owing to that part of the shell being nearly formed and consequently much thinner than other parts; at the posterior or narrower end it is usually truncated in adult specimens, and furnished with a very short sloping and oblique pipe or tubular appendage having a pear-shaped orifice; there is also occasionally at the point on the convex side a notch or groove, in a line with the front or smaller part of the tubular appendage, and this notch is rarely extended into a short and narrow slit or channel. (*Jeffreys*).

Length 37–42, diam. of aperture 4·5–5 mill.

Spitzbergen, Scandinavia, Iceland, and Atlantic coasts of Europe, south to Spain, 3–1750 fms. *Coasts of Maine and Massachusetts, north to Bay of Fundy.*

D. entalis Linn., Syst. Nat. (10), p. 785; (12), p. 1263.—Pennant, Brit. Zool., iv, p. 145, pl. 90, f. 154 (1777).—Lamarck, An. s. Vert., v, p. 345 (1818).—Forbes & Hanley, Nat. Hist. Brit. Moll. ii, p. 449, pl. 57, f. 11 (1853).—Hanley, Ipsa Linn. Conch., p. 437, 548 (1855).—Reeve, Conch. Syst., ii, p. 6, pl. 130, f. 3 (1842).—Jeffreys, Brit. Conch., iii, p. 191, pl. 5, f. 1; v, pl. 55, f. 1 (1865); P. Z. S., 1882, p. 659.—Watson, Challenger Scaph. & Gastr., p. 5 (1885).—*D. entale* L., and *D. antale* of some authors. Not *D. entalis* or *D. entale* of writers on Mediterranean shells, or of Searles Wood and some other palæontologists.—*D. entalum* De Blainv., Dict. Sc. Nat., xiii, p. 70.

D. striolatum Stimpson, Proc. Bost. Soc. Nat. Hist., iv, p. 114 (1851); Shells of New England, p. 28 (1851).—*Entalis striolata* Stimp., Gould–Binney, Invert. of Mass., p. 266, f. 528 (1870). Not *D. striolatum* of Jeffreys, Watson or Sars. Not *D. striolatum* Risso, 1826.

More glossy and ivory-like than *D. vulgare*, usually more distinctly annulated, and with the longitudinal striæ completely wanting except at the smaller end, where their presence is variable. The posterior termination has either a labial projection which is rather broadly fissured dorsally (*i. e.* upon the arched side of the tube) or if it have not experienced that reparative process is then very tapering, and has a short shelving notch-like dorsal fissure; it is always entire upon the ventral or incurved side of the shell. In certain specimens the close approximation of the concentric lines of growth produces a somewhat annulated appearance. (*F. & H.*).

D. entalis is an abundant species on the coast of Maine; and William Stimpson, comparing with the European *D. vulgare* and finding differences, distinguished the American shells as *D. striolatum*,

under which name the species is generally known in American collections. Had he compared with *D. entalis*, the identity of the two would no doubt have been recognized. *There is no difference*, not even varietal, between English and Maine specimens. *D. striolatum* or *Entalis striolata* of Jeffreys, Sars and Watson is *D. occidentale* Stimp. *D. striolatum* of Risso is *D. vulgare*.

There is great latitude of opinion regarding the limits of the species *entalis;* some conchologists holding *occidentale, agile* and *pretiosum* as merely varieties of the Linnæan species. The following variations have been named:

Var. *infundibulum* Jeffr. Shorter and less cylindrical, being proportionally wider toward the mouth. Loch Fyne (*Jeffr.*, Brit. Conch., v, p. 197). Var. *anulata* Jeffr. Narrower and more regularly cylindrical, ornamented with white ring-like marks of growth (*Jeffr.*, Brit. Conch., iii, p. 192).

Var. ORTHRUM Watson.

Rather long and straight, and sharply striate toward the apex, thus combining the form of *D. agile* with the sculpture of *D. abyssorum*.

Setubal, 470 fms.; *Fayal, Azores*, 450 fms.; *Prince Edward Island*, 140 fms. (Challenger); *Gulf of Gascony* (Hirondelle).

D. entalis var. orthrum WATS., Journ. Linn. Soc., Zool., xiv, p. 512 (1879); Challenger Rep., p. 6.—DAUTZENBERG, Mém. Zool. Soc. France, iv, p. 609, 617.

D. PRETIOSUM 'Nuttall' Sowerby. Pl. 13, figs. 1, 2, 3.

Shell rather long, moderately curved and solid; opaque white, ivory-like, often with some faint dirty buff rings or tinted with that color at the smaller end. Sculpture of fine, irregular growth-striæ and occasional deeper grooves caused by interrupted growth; usually with no longitudinal sculpture in adults, but sometimes showing longitudinal striæ toward the apex, the young with numerous small riblets (but in southern specimens the longitudinal sculpture is more persistent). Aperture circular, oblique, the peristome thin. Apex rather broadly truncate, the orifice small, oblong, continued in a short notch on the convex side; often having a narrow raised rim.

Length 55, diam. of aperture 5, of apex 2 mill. (Washington).

Length 41, diam. of aperture 5, of apex 2·7 mill. (Brit. Columbia).

Length 41, diam. of aperture 3·8, of apex 1·5 mill. (Cerros I.).

West coast of America from Sitka, Alaska, to Cerros I., Lower California.

D. pretiosum——Cpr., Moll. W. C. North Amer., in Rep. Brit. Asso. Adv. Sci. for 1856, pp. 296, 317 (name only; "Central America, Dr. Sinclair in Brit. Mus.").—*D. pretiosum* Nutt., Sowb., Thes. Conch., iii, p. 95, pl. 225, f. 57 (1860); Conch. Icon., xviii, pl. 7, f. 54 (1872).—Cpr., Rep. Br. Asso. for 1863, p. 560; (Smiths. Misc. Coll., No. 252, pp. 31, 46).—Williamson, Proc. U. S. Nat. Mus. xv, 1892, p. 194.—Keep, West Coast Shells, p. 113, f. 101 (1887).—*Entalis pretiosus* Nutt., Lord, P. Z. S., 1864, p. 137 (method of capture by aborigines).—*Dentalium* like *entalis*, Vancouvers Isl., Cpr., Rep. Br. Asso., 1856, p. 296.

"*Dentalium* (var.) *Indianorum*," "*Dentalium* (? *pretiosum* Nutt., Sby. var.) *Indianorum*," and "*Dentalium Indianorum*" Carpenter, Rep. Brit. Asso. Adv. Sci. for 1863, pp. 612, 648, 683 (1864); Moll. Western N. A., Smiths. Misc. Coll., no. 252, pp. 98, 134, 169.—*D. indianorum=pretiosum* Stearns, Rep. U. S. Nat. Mus., 1887, pp. 315, 316, f. 8, 9, pl. 1, f. 2 (use as money).—*D. "preciosum"* Clessin, Conchyl. Cab., p. 15, pl. 4, f. 8 (1896).—*D. "pretionum"* James, Journ. Cincinnati Soc. N. H., viii, p. 36 (1885–6).

D. politum Lamk., Middendorff, Beiträge Mal. Rossica, ii, p. 98 (not of Lam.).

D. columbianum Clessin, Conchyl. Cab., vi, Heft x, p. [43], pl. 10, f. 4 (1896).

Very similar to *D. entalis*, of the North Atlantic and perhaps better ranked as a subspecies; but in general the Pacific shell is larger, longer in proportion to the diameter, and whiter; and these differences, with the geographic separation, make it undesirable to unite the forms.

Clessin's *D. columbianum* is merely a short form of typical *pretiosum*, utterly without specific or varietal characters different from *pretiosum* as ordinarily developed in British Columbian waters.

Californian examples are decidedly smaller, and frequently lirate toward the tip. This form has been called

Var. indianorum by Dr. Carpenter, who describes it as "like *entalis*, with very fine posterior striæ." Specimens from Monterey, San Pedro Bay, etc. are so sculptured. In the examples of this form before me the apex is unslit, the anal orifice circular with thin walls. Should these differences prove constant, *indianorum* may perhaps be elevated to specific rank; but in *entalis* the apical features are inconstant. Pl. 13, figs. 6, 7, 8 are normal *indianorum*; figs. 4, 5 are an older shell.

In some specimens of *D. pretiosum* before us the apical notch is excentric, and in one it is directly lateral, as in *D. sericatum*, although having the form usual in *pretiosum* and *entalis*. We have observed similar inconstancy in the position of the slit in some other species.

D. AGILE M. Sars. Pl. 8, figs. 36.

Shell very long and narrow, somewhat attenuated toward the apex; very slightly curved, almost straight, not very solid. White, little shining, generally smooth, rarely lightly striolate toward the apex. Apical fissure rather deep. Length 57 mill. (*G. O. Sars*).

Lofoten Is., etc., Norway (Sars); *Bay of Biscay* (Travailleur); *Mediterranean and Adriatic Seas* (Spratt, Stossich); *Canaries, Azores and Ascension I.*, 420–620 fms. (Challenger, Josephine Exped.); *Between Halifax and La Have Bank* (U. S. F. C.); *Off Morro Light, Havana, Cuba*, 400 fms. (Blake).

D. agile M. SARS, Remarkable Forms of Anim. Life, etc., p. 34, pl. 3, f. 4, 5 (1872).—*Antalis agilis* G. O. SARS, Moll. Reg. Arct. Norv., p. 102, pl. 20, f. 9 (1878).—MONTS., Nomencl. Gen e Spec. Conch. Medit., p. 32.—*D. agile* DALL, Bull. M. C. Z., ix, p. 37 (1881); ibid., xviii, Blake Rep., p. 418 (1889); Trans. Wagner Inst., iii, p. 44 (1892).—STURANY, Ber. Commis. Erforsch. öst. Mittelm, p. 29.—JEFFREYS, P. Z. S., 1882, p. 658; Ann. Mag. N. H. (5), x, p. 30 (1882); Nature i, p. 166, no description (1869).—*D. entalis* var. *agile* Sars, WATSON, Challenger Rep., p. 6 (1885).—SMITH, P. Z. S., 1890, p. 321.—*D. incertum* PHIL., Enum. Moll. Sicil., ii, p. 207, (1844), not *D. incertum* Desh.—*D. vagina* JEFFREYS, see below.—*D. fusticulus* BRUGNONE, Misc. Malac., ii, p. 21, f. 31.

"I now find that, compared with *D. striolatum* or *abyssorum*, the present species is more slender and not so strongly ribbed, and that the curve is more gradual and not abrupt towards the point or base. Perfect specimens of both species have a short terminal pipe within the slit and occasionally issuing from a truncated and thickened base, as in *D. dentalis* and *D. tarentinum*. Philippi was the first to describe *D. agile* from the Italian Tertiaries as *D. incertum* of Deshayes; but it is not the last named species. It was dredged in the 'Porcupine' and 'Travailleur' expeditions off the Lusitanian coasts." (*Jeffreys*).

D. vagina Jeffreys. (Pl. 9, fig. 52). Narrowly cylindrical, rather solid, glossy, smooth. Its peculiarity consists in the posterior termination forming a second and narrower cylinder, which issues

out of the larger and longer one, as if from a sheath. This process has an entire and circular point; so that the shell cannot be a species of *Siphodentalium*. Length 12·5 mill. (*Jeffr.*).

N. Atlantic, Station 16, 1785 fms. (Valorous Exped.).

D. vagina JEFFR., Ann. Mag. N. Hist. (4), xix, (1877), p. 155 (concealed in text relating to *D. subterfissum*).

Described from a dead specimen, which Jeffreys was apparently ashamed to formally introduce as a new species. It is a wretched fragment of a young shell, which owes the projecting tube to loss of the outer shell layer, as described under *D. agassizi*, not to independent growth as in *D. filum, innumerabilis*, and the *vulgare* group. After examining the type and another specimen, we have no hesitation in declaring it a young *D. agile*. At all events, its absolute counterpart can be found in the long-dead young of this species. The figure is an enlarged drawing of the type.

D. OCCIDENTALE Stimpson. Pl. 13, figs. 9, 10, 11 ; pl. 9, figs. 41, 42, 43 (young).

Shell moderately curved, the bend mainly posterior, rather solid, lusterless; whitish, frequently tinted with yellow or fleshy. Sculpture of about 12 rather strong ribs toward the apex, gradually becoming lower and wider anteriorly, and increased to double that number by the intercalation of as many intermediate riblets, all of which become subobsolete toward the aperture, which is oblique and circular. Anal orifice circular not notched or slit, or with a short slit on the convex side.

Length 34, diam. of aperture 3·9, of apex 1 mill.

North Atlantic, from off New England north to Newfoundland; Spitzbergen, Norway and Faroe Is. (According to Jeffreys *south to Bay of Biscay and Azores*).

D. occidentale STIMPSON, Shells of New England, p. 28 (1851); no description, being based on *D. dentale* Gould, Invert. Mass., p. 155, pl. 1, f. 5.—*D. occidentale* VERRILL, Trans. Conn. Acad., v, pl. 42, f. 16–18; Rep. Commissioner Fish and Fisheries for 1883, p. 573, pl. 28, f. 123–125.—WHITEAVES, Rep. on a Second Deep-sea Dredging Exped to the Gulf of St. Lawrence, etc., p. 17 (1873).—*D. dentale* GLD. in Invert. Mass., edit. W. G. Binney, p. 266.—*D. abyssorum* SARS, see below.

This shell has curiously enough been mistaken for *D. striolatum* Stimpson, by Jeffreys (P. Z. S., 1882, p. 659), Watson (Chall. Gastr.,

p. 5) and G. O. Sars (Moll. Reg. Arct. Norv., p. 101). It is, in our opinion, specifically different from *striolatum* Stimp., but seems to be identical with the later *D. abyssorum* M. Sars. *D. attenuatum* Say is a somewhat similar Miocene species, differing in the characters of the apex. The description and synonymy of *D. abyssorum* here follows.

D. abyssorum M. Sars. (Pl. 8, fig. 21; pl. 9, fig. 40). Longer and more slender than *D. entalis;* lightly arcuate toward the apex; less solid. White or ashen, little shining, longitudinally striolate, about 20 (16–24) more distinct striæ at the middle, rarely extending to the aperture, and sometimes quite raised, sometimes less distinct and almost obsolete. Apical fissure moderately deep; sheath or tube around the anal orifice short. Length 50, diam. of aperture 4½, of apex 1 mill.

D. abyssorum M. Sars, Christ. Vid. Selsk. Forh., 1858, p. 52; Om de i Norge Forekommende Fossile Dyrelevninger fra Quartærperioden (University Programme for 1864), p. 42, pl. 3, f. 100–106 (1865), exclusive of the so-called young.—Searles Wood, Crag Moll. Suppl. i, Pal. Soc. Mem., p. 93 (1871); see ibid., i, p. 189, pl. 20, f. 2.—*D. striolatum* Stimp., Jeffr., P. Z. S., 1882, p. 659; Ann. Mag. N. H. (5), x, p. 30.—*D. brevifissum* Brugnone, Misc. Malac., ii, p. 20, fig. 30 (1876).—? *D. cinerascens* Anton, Verzeich. Conchyl. Samml. Anton, p. 25 (1839).—*D. entalis* var. *striolatum* Watson, Chall. Rep., p. 5 (1885).—*Antalis striolata* G. O. Sars, Moll. Reg. Arct. Norv., p. 101, pl. 7, f. 1; pl. 20, f. 10a, b, c; Also folded pl. 1, f. 1 (radula). Not *D. striolatum* Stimpson!—*D. tarentinum* Asbjornsen, Nyt Mag. f. Naturv., 1853, vii, p. 350.—Malm, Göteborgs Vetensk. o Vitterh. Samhälles Handl., viii, 1863, p. 2, f. 3. Not *D. tarentinum* Lam.

Var. sulcatum Verrill.

Shell of moderate size, thin, translucent white, tinged with very pale yellowish or bluish, moderately curved, more decidedly behind the middle, tapering regularly and rather rapidly from the anterior to the very slender posterior end. The entire surface is covered by well marked, nearly regular, narrow raised ribs with nearly perpendicular sides and rounded summits, separated by well-defined, strongly marked, concave grooves which are about twice the width of the ribs anteriorly, but posteriorly are of about the same width. The ribs and furrows show on the interior of the shell within the

aperture, in reverse, the whole thickness of the shell conforming to the sculpture as if they were corrugations of its substance. The oval aperture is relatively large and circular, very little oblique, and usually with the very thin edge more or less broken. Posterior aperture very small, usually plain and without any notches, but in one of the most perfect specimens it has a slight lateral notch on each side; in others there is a small dorsal notch.

Length of one of the largest specimens 20, diameter at the anterior end 3, at the posterior end 0·6 mill. Some specimens are slightly more slender than the one measured. (*Verrill*).

South of Nova Scotia, east of Cape Cod, lat. 41° 9′ 40″ to 41° 13′, long. 66° 2′ 20″ to 66° 50′, at the following Stations: 2076, in 906 fathoms, one living specimen; *station 2077*, in 1255 fathoms, four living, *and station 2079* in 75 fathoms, one living specimen (U. S. Fish Commission).

D. occidentale var. *sulcatum* VERRILL, Trans. Conn. Acad., vi, p. 217 (June, 1884).

This variety resembles *D. candidum* Jeffreys in its form and longitudinal sculpture, but lacks the transverse lines between the ribs; the posterior end is also more slender and more curved than shown in his figure. It also closely resembles some young specimens of the typical *D. occidentale* but the latter has not so strongly marked and regular ribs and grooves, nor does the sculpture extend entirely through the thickness of the shell so as to appear on the inside, as in the present form. Specimens often occur, however, that are evidently intermediate between the two forms, in the character of the sculpture and thickness of the shell. (*Verrill*).

We have not seen this form.

D. ÆNIGMATICUM Jordan. Pl. 9, figs. 58, 59.

Shell subcylindrical, very slender, thin, slightly curved, lusterless, and opaque. Sculpture, 26–28 longitudinal ribs, which are thin, almost sharp, and traverse the entire length of the shell. No longitudinal microscopical striæ are visible between these ribs, merely the usual transverse lines of growth. Color, creamy-white, margin at the anterior end jagged, as is usual in other species of this genus. No notch or slit is visible at the posterior end, which, however, appears when examined by a strong lens to be slightly broken. Length 25, diam. 2 mill. (*Jordan*).

Faroe Channel, "cold area," 640 fms.; *off west coast of Ireland*, in 1000 fms.

Dentalium œnigmaticum JORDAN, Proc. Malac. Soc. Lond., i, p. 264, pl. 16, f. 1a, 1b (July, 1895).

From *D. agile* this species may be distinguished by the persistent ribs which traverse the entire length of the shell, and by its somewhat more slender form. Herr Herman Friele informs me that *D. agile* "is not always so faintly striated as described by Sars." It differs from *D. striolatum* [*occidentale*] in its more slender form and stronger sculpture; from *D. candidum* in its much more slender form, and in not possessing the fine transverse intercostal sculpture of that species; whilst from *D. dentalis* it is distinguished by its more slender form, more numerous ribs (about twice as many), which are thin and not well rounded as in *D. dentalis*, and by not having longitudinal microscopical striæ between the ribs.

The learned author of "British Conchology," in vol. iii, p. 197, says of *D. dentalis*, "It has nine longitudinal ribs, besides frequently a stria between each rib, but no fine impressed lines as in *D. tarentinum;*" but in the specimens of *D. dentalis* which I have examined longitudinal striæ are visible; even in specimens which appeared to be destitute of them, I have with a strong lens detected them in some places when holding the shell at a certain angle to the light, and in many specimens these striæ by their intersection with the lines of growth, impart a microscopical bead-work appearance to the intercostal spaces.

Mr. E. A Smith informs me that there are two specimens of this new species in the British Museum (Natural History) from off the west coast of Ireland in 1000 fms., and that he regards the species as being quite recognizable. (*Jordan*).

Group of D. novemcostatum.

Shell stout and strong, moderately curved, with 9 to 13 principal ribs at and near apex, and usually interstitial riblets. Apex frequently truncate, with a small central tube. Shell often ruddy.

Species of the Mediterranean and immediately adjacent seas, mainly living at slight or moderate depths.

With the inclusion of *D. vulgare*, this group would constitute the genus *Antalis* of Stoliczka, but not the earlier *Antalis* Adams; but it is a matter of common observation that the apical tube is by no means constantly developed in shells of any stage of growth. In the following key some species of the preceding group are included.

Key to species.

I. 9 to 13 strong ribs at and near apex; an equal number of interstitial ribs often developed, or intervals longitudinally striated.
   a. Primary ribs strong, intercalated riblets generally smaller throughout, shell generally ruddy, *novemcostatum, dentalis, inæquicostatum, panormum.*
   a'. About 11 indistinct ribs, intervals longitudinally striated, apex wide; white; (Gulf of Suez). *clavus*, p. 55.
II. 12 or more low ribs at apex, increasing to double that, and becoming lower or obsolete toward aperture, *occidentale*, p. 47.
III. 11–28 primary ribs or riblets, continuous from end to end; no interstitial riblets or longitudinal striæ; white.
   a. 11–13 ribs; length 35 mill., 7 times the diam. *senegalense*, p. 55.
   a'. 26–28 narrow ribs; no apical notch; length 25 mill., 12 times the diam., *ænigmaticum*, p. 49.

D. NOVEMCOSTATUM Lamarck. Pl. 9. figs. 44, 45, 46, 47, 48.

Shell moderately curved, very stout; grayish-white or delicate rose, usually reddish toward the apex and with encircling zones of deeper red. Sculpture of 9 rounded ribs, stronger at the apex, weak or obsolete at the aperture; longitudinally obsoletely striated. Aperture rounded-angular. Apex wide, truncate, the anal orifice small, usually occupying a short tube.

Length 32, diam. of aperture 4·7, of apex 2–3 mill.

Ocean coast of France.

D. novemcostatum LAM., An. s. Vert., v, p. 344 (1818); edit. DESH., v, p. 592 (1838).—DESH., Mém. Soc. Hist. Nat. Paris, ii, p. 356, pl. 16, f. 11, 12 (1826).—DELESSERT, Req. de Coq., pl. 1, f. 2a, 2b (1841).—FISCHER, Actes Soc. Linn. Bord., xxvii, 1869, p. 115.—DANIEL, Journ. de Conchyl., xxxi, 1883, p. 331.—BUQ., DAUTZ. & DOLLF., Moll. du Roussillon, i, p. 565, pl. 66, f. 12–14.—SOWB., Thes. Conch., iii, p. 102, pl. 224, f. 24–27; Conch. Icon., xvii, pl. 3, f. 13*b*, *c*, *d*.—CLESSIN, Conchyl. Cab., p. 5, pl. 1, f. 5.—*Antale novemcostatum* SACCO, Boll. Mus. Zool. ed Anat. Comp. Univ. Torino, xi, 1896, p. 97.

Stouter, comparatively broader in the adult than the Mediterranean *D. inæquicostatum*, and lacking the distinct circular striation of that form.

Sacco recognizes 'varieties' *pseudaprina, mutabilis, inæquicostata decemcostata, undecemcostata, duodecemcostata* and *tredecemcostata* in the Italian Pliocene. They are probably mere forms, and may belong to the closely allied *D. inæquicostatum* Dautz.

D. INÆQUICOSTATUM Dautzenberg. Pl. 9, figs. 49, 50, 51.

Shell moderately or slightly arcuate, either decidedly or slightly tapering, very solid, nearly lusterless. Whitish, with numerous ill-defined orange-red or roseate zones, and suffused with that color toward the apex. Sculpture of 9–12 strong primary ribs toward the apex, narrower than their intervals, which are smooth except for very faint, close longitudinal striation, and rather conspicuous growth-striæ; smaller secondary ribs, alternating with the others, soon appear, and toward the aperture, where the sculpture becomes weaker, some tertiary cords; so the ribs are rather irregularly alternating in size; adults showing some irregular, shallow or deep constrictions around the tube, caused by interrupted growth or breakage. Aperture subcircular, slightly polygonal, somewhat oblique. Apex wide and truncate in adults, with a small, short central tube. No slit or notch.

Length 50, diam. of aperture 4·5, of apex 2 mill. (Specimen).

Length 35, diam. of aperture 5 mill. (*B. D. & D.*).

Mediterranean, from Greece and Sicily to southern France, Algeria and Tunis; laminarian zone.

D. dentalis LAM., An. s. Vert., v, p. 344.—RISSO, Hist. Nat. Eur. Mérid., iv, p. 398.—DESH., Mém. Soc. H. N. Paris, ii, p. 353, pl. 16, f. 9, 10.—PHILIPPI, Enum. Moll. Sicil., i, p. 243; ii, p. 206.—JEFFREYS, Ann. Mag. N. H., 1870, p. 10.—MONTEROSATO, Not. int. alle Conch. Medit., p. 28; Conch. delle Rada di Civitavecchia, p. 8. Not *D. dentalis* Linné.

D. fasciatum LAM., l. c., p. 343. Not *D. fasciatum* Gmel.

D. novemcostatum Lam., PAYR., Moll. de Corse, p. 19.—JEFFREYS, Moll. Piedm. Coast, p. 26.—WEINKAUFF, Conch. des Mittelm., ii. p. 420.—MONTEROSATO, Nom. Gen. e Spec., p. 31. Not *D. novemcostatum* Lamarck.

? *D. striatulum* DE BLAINV., Dict. Sci. Nat., xiii, p. 70 (1819).

D. pseudo-antalis SCACCHI, Catal. Conch. Reg. Nap., p. 17 (1836). Not *D. pseudo-antalis* Lamarck.

D. alternans BUQ., DAUTZ. & DOLLF., Moll. Mar. du Roussilon, i, p. 561, pl. 66, f. 7, 8, 9. Not *D. alternans* Chenu.

D. inæquicostatum DAUTZENBERG, Mém. Soc. Zool. France, pour 1891, p. 53 (footnote); Ibid., 1895, p. 370.

The vicissitudes of nomenclature suffered by this species have been ably elucidated by the learned authors of Les Mollusques Marins du Rousillon; and as their material has been so much more extensive than any we have access to, we are content to accept their separation of the form from *D. novemcostatum* Lam. and *D. dentalis* Linné.

D. DENTALIS Linné. Pl. 9, figs. 55, 56, 57.

Shell moderately curved, rather slender; whitish, zoned and suffused toward the smaller end with rose; sometimes uniform white. Sculpture of *about 10 strong rounded ribs near the apex, rapidly increasing by the intercalation of intermediate riblets to 18 or 20 at the aperture.* Aperture rounded, polygonal, slightly oblique. Anal orifice small, circular, with very thick walls. No notch or slit. Length 24, diam. of aperture 2·8, of apex 0·8 mill. (or somewhat larger).

Mediterranean and Adriatic Seas; Sea of Marmora.

D. dentalis LINNE, Syst. Nat. (12), p. 1263 (1766).—HANLEY, The Shells of Linnæus, p. 436.—O. G. COSTA, Faun. Reg. Nap., Tubibranchi, p. 16, pl. 1, f. 3.—MONTS., Nom. Gen. e Spec., p. 31.—BUQ., DAUTZ. & DOLLF., Moll. Mar. Roussillon, i, p. 564, pl. 66, f. 10, 11.—CLESSIN, Conchyl. Cab., p. 6 (in part).—STURANY, Berichte der Commiss. für Erforsch. des Ostlichen Mittelm., p. 120, in Denkschr. K. Akad. Wissensch., lxii, 1895.—DAUTZENBERG, Mém. Soc. Zool. France, iv, p. 609.—CARUS, Prodromus Faun. Medit., p. 174.—*D. dentale* and *D. linnæanum* LOCARD, Prodr. Mal. Francaise, in Ann. Soc. d'Agricult., etc. de Lyon (5), ix, for 1886, p. 145 (1887); Coq. Mar. France, in Ann. Soc. Linnéenne de Lyon, for 1890, p. 238 (1891).—? *D. simile* S. BIONDI GIUNTI, Atti Accad. Gioenia de Sci. Nat. (2), xiv, p. 120, pl., f. 6 (1859).—*D. mutabile* DODERL. in Hörnes, Foss. Moll. Tertiär-Beckens von Wien, in Abhandl. K.-K. Geol. Reichsanst., iii, p. 654, pl. 50, f. 32 (1856).

Closely allied to *D. inæquicostatum*, with which, indeed, it may have been associated by Linnæus. Sacco has named "varieties" *astensis, sexdecimcostata, quatuordecimcostata, paucicostulata* and *maculatellata* from the Italian Pliocene. It is an interesting collection of Latin compounds, but probably without adequate foundation in nature.

Foresti, in Bull. Soc. Mal. Ital., xix, p. 249–252, admits these varieties from the Pliocene: (1) *alternans* B. D. D., (2) *obsoleta* Dod. (=*D. obsoletum* Doderlein, Cenn. Geol. giacim. terr. Mioc. sup. Ital. Centr., p. 15, 1862;=*D. dentalis* var. *sublœvis* Cocconi, Enum. sistem. Moll. Mioc. e Plioc. Parma e Piacenza, p. 240, 1873), and (3) *œquicostata* Foresti, 1895. Whether these are really referable to *dentalis* or not is uncertain; the recent forms of this group are certainly closely allied though probably specifically distinct, but some convergence is to be expected in the tertiaries.

D. PANORMUM Chenu. Pl. 9, figs. 38, 39.

Shell slender and elongated, moderately curved, solid. Flesh-tinted, or opaque white and tinted posteriorly, where it is also often encrusted with a black deposit. Sculpture of about a dozen unequal narrow riblets at the apex, increasing in number but losing in prominence as the tube enlarges; growth striæ scarcely noticeable, but there is often a deep jagged encircling constriction where a former fractured peristome has been repaired. Aperture circular, hardly oblique. Anal orifice small, circular or ovate, with thick walls.

Length 53, diam. of aperture 4, of apex 1 mill.

Length 70, diam. of aperture 4, of apex 1·5 mill.

Mediterranean and Adriatic Seas; Bay of Biscay, 30–195 fms.

D. panormum CHENU, Ill. Conch., i, p. 6, pl. 6, f. 13 (1842–1847). —*D. panormitanum* JEFFREYS, P. Z. S., 1882, p. 657.—STURANY, Denkschr. Kais. Akad. Wissensch. Wien., lxiii, Berichte der Commis. für Erforsch Ostl. Mittelm., p. 29.—*D. lessoni* SOWB., Thes. Conch., iii, p. 100, pl. 224, f. 17, 18.—? And CLESSIN, Conchyl. Cab. p. 7. Not of Deshayes.— ? *D. arguticosta* BRUGNONE.

D. pseudoantalis O. G. COSTA, Fauna Reg. Nap., *Dent.*, p. 17, pl. 1, f. 2, 8 (1850).

Independently of the much greater length, the ribs are finer and far more numerous and regular, (than in *dentalis*), and they are extremely slight or become mere striæ on the anterior part or in front. The shell is also more tapering and proportionally narrower. It attains the length of 3 or 4 inches. Some specimens have the same pipe at the posterior extremity as in *D. dentalis*. (*Jeffr.*).

D. panormum, like the very closely allied *dentalis* and *inœquicostatum*, repairs a broken peristome very clumsily, leaving a gaping record of the injury, deeper than in most species of the genus; such breaks

being seen in the majority of adult specimens. *D. semiclausum* Nyst has been referred here, but is probably distinct.

D. CLAVUS Cooke. *Unfigured.*

Shell solid, whitish, ungraceful, slightly arcuate, almost equally wide from apex to base; fluted with about 11 very indistinct ribs, interstices longitudinally lineated, the lines sometimes nearly equal to the ribs; apex entire. Length 1·75, diam. 0·2 inch. (*Cooke*).

Gulf of Suez (MacAndrew).

D. clavus COOKE, Ann. Mag. Nat. Hist. (5), xvi, p. 275 (Oct., 1885).

A remarkably ungraceful shell, reminding one of thick specimens of *novemcostatum* Lam. The breadth is almost the same throughout, ribs very indistinct and impossible to count at the base, interstitial lines proportionately strong. (*Cooke*).

D. SENEGALENSE Dautzenberg. Pl. 13, figs. 13, 14, 15,

Shell 35 mill. long, 5 wide at base; rather thin, elongate, arcuate, ornamented by 11–13 longitudinal narrow continuous ribs, narrower than their intervals, and very delicate growth-striæ between them, the interstices without longitudinal sculpture. Apex entire. Aperture polygonal, the peristome very acute, with 11 to 13 grooves within corresponding to the external longitudinal ribs. Color uniform dull, milk white. (*Dautz.*).

Dakar, Senegal, ('Melita' Exped.).

D. *senegalense* DAUTZ., Mém. de la Société Zoologique de France pour l'année, 1891, iv, p. 53 (p. 38 of separate copy), pl. 3, f. 8a, 8b, 8c.

D. senegalense approaches *D. dentalis* L. of the Mediterranean in the equal ribs and white coloring; but it has only 11 to 13 longitudinal ribs instead of 20, it enlarges more rapidly toward the anterior end. It is less like the Mediterranean form described by us as *D. alternans* (which name being in use for an earlier species described by Chenu, we propose to replace by *D. inæquicostatum*), which has alternately larger and smaller ribs. Finally, the shell approaches *D. lessoni* Desh., reported by Lesson from New Guinea. (*Dautz.*).

GROUP OF D. DISPARILE.

Irregularly many-ribbed species of rather small size, often with alternating translucent and opaque encircling bands, or dots on the ribs; apex either simple, notched or tubiferous.

A few Antillean and Pacific species are grouped here for want of a better place.

D. DISPARILE d'Orbigny. Pl. 14, figs. 16, 17, 18, 19, 20, 21.

Shell small, solid, moderately curved, opaque white, frequently with some or all of the ribs articulated with dots and dashes of translucent gray. Sculpture, 9 or 10 primary ribs with smooth (or 1-ribbed) interstices at and near the smaller end, increasing by intercalation to somewhat over double that at the aperture, the interstitial riblets developed earliest and most numerously on the convex side of the shell, where they become as prominent as the primary ribs; several of the latter, on the concave side of shell, frequently continuing prominent to the aperture. Aperture circular, outer margin of peristome crenulated by the riblets. Anal orifice small, without slit or notch, frequently bearing an inner tube (figs. 20, 21).

Length 20, diam. of aperture 2·3, of apex 1 mill. (St. Martin).
Length 19·5, diam. of aperture 2·2, of apex 0·7 mill. } Marco,
Length 20, diam of aperture 1·9, of apex 0·7 mill. } Florida.
Length 25, diam. of aperture 3 mill. (Turks I.).

Coast of Florida, in 2–10 fms. (Hemphill, Rush, Vodges *et al.*); *Martinique* (Orbigny); *Bahamas* (Rawson, Gabb); *Havana, Cuba* (Arango); *Samana Bay, St. Domingo* (Couthouy); *Barbados*, 100 fms., (Blake Expedition); *St. Martin* (Marie); *Miocene and Pliocene of the Carolinas and Florida.*

D. disparile ORB., Moll. Cuba, ii, p. 202, pl. 25, f. 14–17 (1842). —DALL, Bull. M. C. Z., ix, p. 37, 1881 (ex parte); Ibid, xviii, Blake Rep., p. 424 (1889); Trans. Wagner Inst., iii, p. 440; Bull. U. S. Nat Mus. no. 37, p. 76.—ARANGO, Cont. Faun. Mal. Cub., p. 232 (1878).

"This species has no notch or slit when perfect; when truncate it repairs damages by projecting a small tube from the broken end (figs. 20, 21). It recalls *D. panormitanum* Jeffreys, but is smaller, less uniform in sculpture, and has no notch. At the posterior end it is circular, with the exterior crenulated by the ribs; by this feature it is distinguished from some of the allied species whose posterior section is polygonal." (*Dall*).

D. disparile has the ribs more unequal than in *D. antillarum*, and fewer in number at the aperture. Of course the count of ribs at the apex depends upon the age of the individual specimen, the secondary riblets being added very early on the convex side.

D. disparile is very similar to *D. variabile* Desh. The Oriental locality of the latter rests upon little satisfactory evidence, unless Martens' identification of Anderson's shells proves unquestionable. We do not know that the gray-dotted pattern of the ribs in this species and *D. antillarum* has been noticed in print hitherto, though it is obvious enough in many specimens.

D. CERATUM Dall. Pl. 7, figs. 4 (young) and 5.

Shell of waxen hue becoming whiter toward the mouth, aculeate, slightly curved, rather stout, and of glassy texture; *at the anal end septangular, the angles passing into riblets at the beginning of the middle third, then becoming gradually much more numerous, finer fainter, and lastly absent or evanescent on the oral third.* Surface shining, apertures simple, circular. Length 30, anal diam. 0·5, oral diam. 2·0 mill. (*Dall*).

West Florida, 50 fms. (Pourtalès); *Off Havana*, in 119–177 fms.; *Off Morro Light, Havana*, in 175 to 250 fms.; *Off Virgin Gorda* dead, in 1097 fms. In 213 fms., *off Martinique; Barbados*, 100 fms.; *Off St. Vincent*, in 424 fms., sand (Blake). Also by the U. S. Fish Commission, *south of Cuba*, in 250 fms., coral.

D. ceratum DALL, Bull. M. C. Z., ix, p. 38 (1881); Ibid, xviii, Blake Rep., p. 424, pl. 26, f. 5; pl. 27, f. 2; Bull. U. S. Nat. Mus., no. 37, p. 76, pl. 26, f. 5.

This species has about the curve and proportions of *D. circumcinctum* Watson, but is much smaller, has a wholly different sculpture and no anal notch.

D. ceratum also recalls *D. panormitanum*, but is always more slender, usually shorter, has a yellow waxen instead of an apricot tint, and the raised sculpture is finer, and more uniform. *D. ceratum* has a shallow wave above and below at the anal end, while *D. panormitanum* has a true, though short, slit. (*Dall*).

D. ANTILLARUM d'Orbigny. Pl. 14, figs. 22, 23, 24, 25.

Shell small, rather stout, solid; apical third quite strongly curved, the remainder but slightly or moderately arcuate. White, or with a faint greenish-yellow tint; all or part of the ribs frequently seen to be articulated with dots and dashes of translucent gray. Sculpture of numerous (about 37–43 at the aperture) subequal or alternately smaller longitudinal close riblets, about as wide as the interstices, rather low and rounded; towards the apex the riblets become

unequal, fewer by loss of those intercalated in the interstices, and the remaining ribs, about 20 in number, are alternately large and small (and in younger shells there are 10 strong ribs). Aperture circular. Anal orifice small, ovate with thick walls, and a wide, shallow triangular notch on the convex side.

Length 23·5, diam. of aperture 2·5, of apex 1·3 mill.

Length 22·5, diam. of aperture 2·3, of apex 0·9 mill.

Entire West Indies and Gulf of Mexico; north in deep water to Cape Hatteras. Barbados, Dominica, Martinique, St. Vincent, Grenada, Santa Cruz, Arrowsmith Bank, Yucatan, and Yucatan Strait; off Cuba; off Cape Fear, N. C. (Blake and Albatross); *Off Cape Hatteras* (Rush), 17–1000 fms., *Pourtales plateau* (Iowa S. U. Bahama Exp.); *St. Martin, Saba and Key West, Florida* (Acad. coll.); *St. Thomas* (Orbigny).

D. antillarum Orb., Moll. Cuba, ii, p. 202, pl. 25, f. 10–13 (1842 or 1846).—Dall, Bull. M. C. Z., ix, p. 37 (1881); Ibid. xviii, Blake Rep., p. 421 (1889); Nat. Hist. Bull. State Univ. Iowa, iv, no. 1, p. 20.

The riblets on the larger portion of the tube are much more equal and less coarse than in *D. disparile* Orb., a species often occurring with this one, and of equally wide distribution. d'Orbigny's description and figures were from a young specimen.

Dall writes as follows: This well marked species is uniformly finely grooved from the tip to the anterior part, the interspaces being rounded, subequal, and thread-like, growing slightly finer anteriorly. The section is circular, the notch is on the convex side, shallow and wide, often decollate. I believe its range extends north to New England, and possibly to Nova Scotia, in deep water, judging by specimens so labelled in the National Museum.

D. taphrium Dall.

Shell short, stoutish, slightly curved, pale apple-green, which is so alternated in ill-defined zones of translucency and opacity as to give on a fresh specimen the effect of the silk known as moire antique, though the sculpture is not modified in these zones; sculpture of very fine sharp slightly elevated incremental lines, visible only in the interspaces between the longitudinal threads; the latter are even, squarish, rather flattened threads, with subequal channelled interspaces, about six threads to the millimeter of circumference; close to the aperture they become faint, and posteriorly every alter-

nate thread is weaker until it disappears. Both orifices are circular, the anal one has the upper, and to a less degree the lower edge gently concavely waved, but without a slit. Generally this end is decollate and circular. Length of shell, 17·0; height of arch from chord, 2·4; diameter of aperture, 2·12; of anal orifice, 0·5 mill. (*Dall*).

Off the Carolina coast, in 22 to 52 fms., sand; at U. S. Fish Commission Stations 2598, 2608 and 2612. Station 2405, *in the Gulf of Mexico between the Mississippi delta and Cedar Keys, Florida*, in 30 fms., sand.

D. taphrium DALL, Bull. M. C. Z., xviii, Blake Rep., p. 422 (1889); Bull. U. S. Nat. Mus., no. 37, p. 76.

A couple of specimens were obtained, dead and white, in 182 fms., coral sand, off Havana, Cuba, by the U. S. Fish Commission. These though decollate behind, were about nine millimeters longer anteriorly than any of the more northern specimens, without gaining much in diameter. The added part was almost destitute of sculpture. (*Dall*).

D. PHANEUM Dall. Pl. 20, fig. 24 (enlarged).

Shell rather thin, pale straw color, glistening, nearly straight, the curve chiefly in the earlier third; the shell originally is smooth or with few, feeble elevated lines, which in traversing the distance from the apex to the aperture revolve one-fourth of a turn to the right; surface marked by delicate annular lines of growth and longitudinally by about twenty-five very fine, sharp, little elevated threads, which are strongest about the middle of the shell and more or less obsolete in front and behind; between these are faint obscure longitudinal striæ; both orifices of the shell are simply circular, the anterior sharp-edged and a little oblique. Length of the shell, 35; anterior diameter, 2·2; apical diameter, 0·5; maximum deviation of the curve from a chord drawn between the ends, 3·2 mill. (*Dall*).

Off Honolulu, Hawaiian Is., 298–351 fms. (Albatross).

Dentalium phaneum DALL, Proc. U. S. Nat. Mus., xvii, 1894, p. 686, pl. 26, f. 1.

This species is perhaps most nearly allied to *D. antillarum* Orbigny, of the Antilles, a species which differs in its sharper and more numerous ribs, which become more prominent toward the apex instead of obsolete.

Of Pacific species, *D. numerosum* Dall, a form which occurs in very deep water from the Galapagos to California abundantly, has the most general resemblance to the present species; but it grows to nearly twice the length, and when closely examined is seen to have a sharply pentagonal posterior section with a conspicuous ventral slit. *D. numerosum* is a somewhat straighter and longer shell than *D. phaneum*. (*Dall*).

D. VARIABILE Deshayes. Pl. 14, figs. 26, 27, 28.

Shell rather small, moderately arcuate, not much attenuated posteriorly, solid; white, with numerous encircling grayish-translucent zones, more pronounced on the *ribs, which appear articulated with grayish and white.* Sculpture of 10 or 11 strong narrow ribs with concave interstices, at and near the apex; a median thread soon arising in each interval, and becoming nearly equal to the primary ribs, and later other interstitial riblets arise in some intervals, so that at the aperture there are about 22, 24 or more riblets. Aperture round, slightly polygonal. Anal orifice small and circular with thick margin. No slit or notch.

Length 19, diam. aperture 2, diam. apex 1·1 mill.

Length 18, diam. aperture 2, diam. apex 1 mill.

Mergui Archipelago at Mergui on mud-flats and *Sullivan I.* in 7–10 fms. (Anderson); *Philippine Is.* (Sowb., Acad. Coll.) *found at a dealers with mainly small Indian shells* (Desh.).

D. variabile DESH., Mém. Soc. Hist. Nat. Paris, ii, p. 367, pl. 16, f. 30 (1825).—SOWERBY, Thes. Conch., iii, p. 101, pl. 224, f. 30 (1860); Conch. Icon., xviii, pl. 4, f. 26 (1872).—MARTENS, Journ. Linn. Soc. Lond., xxi, p. 200. Not *D. variabile* Costa or Risso.

Differs from *D. belcheri* in being narrower and less rapidly enlarging. The dotted ribs are characteristic, but their number varies considerable. It sometimes reaches 30 mill. length. Compare *D. disparile* Orb.

D. BELCHERI Sowerby. Pl. 14, figs. 29, 30.

Shell subcylindrical, equally and closely ribbed, lightly curved towards the apex; white or roseate, with pale maculation on the ribs; apex entire and obtuse. (*Sowb.*).

Length 32, greatest diam. 5 mill. (from fig.).

Length 26, greatest diam. 4·5 mill. (from fig.).

East Indian Archipelago (Sowb.).

D. belcheri Sowb. jun., Thes. Conch., iii, p. 101, pl. 224, f. 28, 29 (1860); and in Conch. Icon., xviii, pl. 1, f. 1*a*, 1*b*. (1872).

It is like *D. novemcostatum*, but with the ribs much more numerous. There is a slight articulated appearance on the costæ. (*Sowb.*).

D. aculeatum Sowerby. Pl. 10, fig. 66.

Shell white, strongly curved, unequally striated; apex attenuated, acuminate, entire. Not unlike the young of *D. tarentinum*, but more acuminated, and with unequal instead of equal striæ. (*Sowb.*).

Length 21, diam. 3·5 mill. (from fig.).

Habitat unknown.

D. aculeatum Sowb., Thes. Conch., iii, p. 100, pl. 225, f. 63 (1860).

D. dacostianum Chenu. Pl. 13, fig. 12.

Shell small, somewhat arcuate, with very numerous and crowded longitudinal striæ. (*Chenu*).

Length 7·5 mill. (from fig.).

Habitat unknown.

D. dacostatianum Chenu, Illustr. Conch., i, p. 3.—*D. dacostianum* Chenu, pl. 6, f. 33.

Evidently a young shell and a doubtful species. The figures show five strong ribs at apex and 16 fine ones at aperture.

Subgenus Heteroschisma Simroth, 1895.

Heteroschisma Simroth, in Bronn's Klassen u. Ordnungen des Thier-Reichs, iii, Moll., p. 460 (1895).

Shell coarsely striate or ribbed longitudinally, tapering, and with a apical slit *on the concave side.*

An abnormal position of the slit occurs in some other species, such as *D. leoninæ*, *D. inversum* and *D. sericatum*, belonging to quite different groups. It is no evidence of common origin, so that the group established by Simroth for all species with the slit on the concave side, is to that extent an artificial one. If adopted as a subgeneric or sectional name it may be restricted to species of the *subterfissum* type.

D. subterfissum Jeffreys. Pl. 7, figs. 15, 16, 17, 18, 19.

Shell slender and finely tapering, more curved towards the point, rather thin, nearly semitransparent, and glossy; sculpture, from 12 to 16 delicate and sharp regular longitudinal striæ, which are con-

tinued to both ends; color whitish; margin at the posterior end bulbous; slit long and narrow, placed on the lower or ventral side; its length is double that of the greatest diameter of the shell. Length 0·6, breadth 0·075 inch. (*Jeffreys*).

Davis Strait, 1785 fms.; *Off West coast of Ireland*, 1180–1476 fms. (Porcupine Exped.); *off Azores Is.*, 1000 fms., *Palma*, *Canaries* 1125 fms., *and off Pernambuco*, *Brazil*, 675 fms. (Challenger).

D. subterfissum Jeffr., Ann. and Mag. N. H. (4), xix, p. 154 (Feb., 1877); Proc. Zool. Soc. Lond., 1882, p. 660, pl. 49, f. 3.—Watson, Challenger Scaphopoda and Gastrop., p. 10, pl. 1, f. 10 (1885).

Peculiar in having the slit on the concave side of the tube.

D. callithrix Dall. Pl. 7, fig. 3.

Shell white, moderately curved, laterally slightly compressed; sculpture of *about nine primary longitudinal ridges*, angulating the section, with *between them toward the middle of the shell three to five secondary smaller rounded threads*, crossed by moderately strong lines of growth; the primaries are strongest posteriorly, they become fainter in front and all the longitudinal sculpture nearly uniform near the aperture in the adult; aperture oblique, rounded oval, the lower lip in advance, margin thin; anal orifice circular, simple in the young, without notches or slits; adults usually show a short broadish *slit on the concave side*, or are irregularly eroded; the extreme tip in the young is more curved than the body of the shell, and quite acute. Length 25; height of arch above chord, 5; vertical diameter of aperture, 3·75; transverse ditto, 2·75; diameter of anal end in young, 0·25; in figured specimen (eroded) 1 mill. The shell may attain a length of 43 mill. (*Dall*).

Yucatan Strait, 640 fms.; *Gulf of Mexico*, Blake Station 20, in 220 fms.; Station 41, in 860 fms.; *near Guadelupe*, in 769 fms., sand, *off Santa Lucia*, in 423 fms., ooze, *off Bequia*, in 1591 fms., *ooze*; *off Cape Fear*, in 161 fms., ooze; *off Grenada*; *Also at U. S. Fish Commission Station 2678*, in 731 fms., ooze, *off Cape Fear, North Carolina, and in the Gulf of Mexico, between the delta of the Mississippi and Cedar Keys, Florida*, in 1181 fms., mud; *S. of St. Kitts*, 687 fms.; *East from Tobago*, 880 fms. (Albatross); *Rio Janeiro* (U. S. Expl. Exped.).

D. callithrix Dall, Blake Rep., Bull. M. C. Z., xviii, p. 427, pl. 27, f. 10 (1889); Bull. U. S. Nat. Mus., no. 37, p. 76, pl. 27, f. 10; Proc. U. S. Nat. Mus., xii, 1889, p. 294 (1890).

This is a very characteristic species, in which the longitudinal sculpture, and even the shell, are often somewhat spirally twisted as much as one-eighth of the circumference. (*Dall*).

There are at first 9 narrow, acute ribs, with smooth, wide concave intervals; then 3, 4 or more narrow riblets appear in each interval and the section of the tube becomes circular. Toward the aperture, which is slightly compressed laterally, there are subequal, fine and inconspicuous riblets. The slit is rather long and on the concave side.

Subgenus Fissidentalium Fischer, 1885.

Fissidentalium Fischer, Manuel de Conchyliologie, p. 894 (1885), type *D. ergasticum* Fisch.

Schizodentalium Sowerby, Proc. Malac. Soc. Lond., i, p. 158 (1894), type *S. plurifissuratum* Sowb.

Shell large and solid, sculptured with many longitudinal riblets, the apex typically with a long slit, but often simple, sometimes with a slit divided into a series of fissures.

Mainly deep water species, of all temperate and tropical seas, distinguished chiefly by the large size and solidity of the shell with numerous longitudinal riblets. The apical slit is a frequent but by no means invariable feature, being here an extremely mutable character, as in most other groups of the genus. It is this great variability, not only between different species but among the individuals of the same species, that has induced us against preconceived opinions to merge Mr. Sowerby's group *Schizodentalium* into Fischer's earlier subgenus. The extraordinary character of a slit divided into a series of fissures might well induce any conchologist to found a new genus; but the essential agreement of the type species with *Fissidentalium* in sculptural characters and contour, the variation in number of the fissures, and the existence of the same character to some degree in other species (*capillosum* and *exuberans*), all seem to us to indicate the minor importance of this modification of the slit, in common with the other several types of apical structure. In this case, as throughout the *Scaphopoda*, data upon the soft anatomy are required.

Wide as is the distribution of species of this group in modern seas, the range in time is not less marked. Characteristic fossil forms are *D. grande* Desh. of the Paris Basin Lower Eocene, a species not unlike *D. capillosum; D. giganteum* Sowb. and *D. corrugatum* Gay

of the southern extremity of South America, both probably Miocene or later; *D. mantelli* Zittel and *D. solidum* Hutton of the New Zealand upper Eocene or lower Miocene, and other species.

The following is a very imperfect analysis of the species.

Key to species.

I. Shell circular or nearly circular in section.

a. 12–14 high, rather acute ribs toward apex, with numerous riblets developing as the tube enlarges; shell large, nearly straight; a long often sinuous fissure. Length 63–114 mill. *rectum*, p. 81; *delessertianum*, p. 81.

a'. Longitudinal riblets or ribs much more numerous.

b. Slit divided into a series of fissures by bridges of shell.

c. Stout; length 95 mill., about 5½ times the greatest diam.; off West Africa, *exuberans*, p. 78.

c'. Length 64 mill., about 8–9 times the diam.; many unequal ribs and striæ; fissures 2 to 5; Hong Kong?, *plurifissuratum*, p. 82.

b'. Slit simple or wanting.

c. Caliber quite rapidly enlarging, the diameter generally contained 4 to 7 times in the length.

d. 50–80 riblets on larger part of the very stout shell.

e. Very large, yellowish, with about 50 riblets; aperture oblique, no slit; length 90–99 mill., 5–5½ times the greatest diam.; E. Pacific, *megathyris*, p. 67.

e'. 70–80 riblets; a slit; length 42–45 mill., 4¾–6 times the diam.; Pacific, *ceras*, p. 68.

e''. Nearly straight, brownish-yellow, with a short fissure; about 50 very slightly raised rounded ridges, faint toward aperture; length nearly 50 mill., about 6½ times the diam., *amphialum*, p. 71.

d'. 30–36 riblets toward larger end, either alternately smaller or only half as many

at apex; length 56–60 mill., 7–8 times the diam.; New Zealand,
opacum, p. 70; *zelandicum*, p. 70; *pacificum*, p. 70.

d''. About 18 ribs at larger end, fewer posteriorly; white, rapidly tapering, curved; length about 16 mill., about 6 times the diam.; New Zealand, *huttoni*, p. 71.

c'. Tube less rapidly enlarging, the greatest diameter contained 8 to 11 times in the length.

d. 30–35 riblets on larger part of the shell; length about 8 times the diameter.

e. Long, conic, finely tapering, white; 30–35 unequal, rounded, close, high ridges, finally obsolete except for slight grooves; a short slit; length 62 mill.; *aegeum*, p. 69.

e'. About 30 unequal grooves near large end, fewer posteriorly; white, solid, slightly curved; length 60 mill.; New Zealand,
pacificum, p. 70.

d'. 40 or more flattened riblets separated by much narrower grooves.

e. About 40 subequal riblets with much narrower intervals; toward apex alternately smaller; length 90–133 mill., 8–9 times the diam.; a deep slit or none, *vernedei*, p. 80.

e'. Solid, glossy, white or ashy-gray, about 44–48 low, rather flattened riblets, somewhat fewer posteriorly, parted by linear grooves, becoming subobsolete toward aperture; length 74–88 mill., about 9 times the diam., slit short. *candidum*, p. 72.

e''. Similar, but 90 or more riblets, continuous to aperture; length 100–110 mill., 8–10 times the diam.,
meridionalis, p. 73.

e''''. About 40 narrow riblets at apex, becoming flattened and then obsolete; slit 15 mill. long; length 91 mill., 9 times the diam., *ergasticum*, p 74.

e'''''. Light red; length 82 mill., about 7 times the diam., *milneedwardsi*, p. 75.

e''''''. More cylindrical than *candidum;* length 78 mill., about 9 times the diam., *complexum*, p. 76.

d''. Many thread-like riblets separated by deeply cut intervals hardly narrower than the riblets.

e. Solid, about 65 even, sharply and deeply cut rounded equal threads, with narrow grooves; a slit; length about 80 mill., 9 times the diam., *capillosum*, p. 77.

e'. About 40 flat-topped riblets, with broad square furrows, *paucicostatum*, p. 78.

e''. Striation coarser, slit longer; length 101 mill., about 7½ times the diam., *magnificum*, p. 78.

e'''. Sculpture much as in *capillosum;* light reddish-gray; nearly straight; length 95 mill., 10½ times the diam., *scamnatum*, p. 79.

e''''. About 80 thread-like riblets; a notch or short slit; length 90 mill., about 10 times the diam., *profundorum*, p. 79.

c''. Diam. contained 15 times in length; 75 mill. long; finely ribbed, *senivestitum*, p. 75.

II. Shell decidedly compressed, elliptical in section.

a. Tawny, banded with brown; very numerous unequal riblets; slit long and narrow, aperture oval; length 72 mill., 6 times the diam., *hungerfordi*, p. 84.

a'. White; about 16 angular, narrow, equal ribs, smaller ones sparsely intercalated toward aperture; intervals conspicuously transversely striated; a long slit; length 51 mill., 12–13 times the diam., *clathratum*, p. 84.

D. MEGATHYRIS Dall. Pl. 15, figs. 29, 30, 31.

Shell *remarkably stout and solid, rapidly enlarging;* the earlier third moderately curved, the remainder much straighter. Surface where not eroded shining; texture of shell porcellanous within, with an external chalky stratum under the smooth exterior; the posterior half generally much eroded even in living specimens. Color yellowish-white, generally with some dark extraneous matter lodged in the interstices. Sculpture: *numerous (about 50) strong longitudinal riblets* and threads, the latter rather sparsely and irregularly interposed; the intervals deep and generally somewhat narrower than the riblets; longitudinals rather abruptly losing in strength near the aperture in aged shells. *Aperture* (fig. 29) *decidedly oblique*, somewhat wider than long, the peristome subsinuous, acute. Apex with simple, circular, sharp-edged orifice (fig. 31). *No slit or notch.*

Length 99, greatest diam. of aperture 18·1 mill.

Length 97, greatest diam. of aperture 17·9, diam. at apex 2·7 mill.

Length 95, greatest diam. of aperture 17·5, antero-posterior diam. 15·5 mill.

Length 91, greatest diam. of aperture 18, antero-posterior diam. 16·5 mill.

Off Chiloe Island and southeast Chili in 1050 and 1342 fms. *near Galapagos Is.* in 812 fms.; *off Ecuador* in 1740 fms.; *Gulf of Panama; s.-w. of Tehauntepec*, 2282 fms.; *off Mazatlan*, 995 fms.; *Gulf of California off La Paz*, (U. S. Fish Commission).

Dentalium megathyris DALL, Proc. U. S. Nat. Mus., xii, p. 293, pl. 9, f. 1.—STEARNS, Proc. U. S. Nat. Mus., xvi, p. 424 (1893).

This is one of the finest species of the genus, and the stoutest known. Dall writes: "The young recalls *D. ceras* Watson, but the shell changes in rate of increase and form of longitudinal ribs as it grows. It is a little straighter near the anal end, and the adult is more funnel-shaped, with flatter ribs than in *D. ceras.*

"The radula is short, with the formula $\frac{1}{1+1+1}$. The median tooth is wide, subrectangular, arched a little in front. The laterals on each side have a projecting stout cusp; the uncini are flat rhomboidal plates. The whole radula bears a strong resemblance to that of *Entalis striolata* as figured by G. O. Sars. The oesophagus is short; the stomach short and cordate, stuffed with foraminifera. The soft parts, as preserved in alcohol, seem ridiculously small and out of proportion to the massive shell."

D. CERAS Watson. Pl. 3, fig. 41.

Shell like one of the old drinking-horns, stumpy, short, and a good deal bent, rather thin; the newer growth porcellanous, the older chalky and given to break off in flakes, leaving a perfectly smooth, brilliant porcellanous core. Sculpture: The surface is covered with close-set annular striæ, which, especially on the longitudinal ribs, show like minute, crisp, round threads. The longitudinal ribs are very much stronger, but still are fine, rounded, parted by rounded furrows much like the ribs; both, but especially the furrows, are irregular in size, fresh riblets arising in the hollows. There are from 30 to 35 toward the apex, and from 70 to 80 toward the mouth. Color, pure white. Edge thin and broken at the mouth; at the apex there is an irregular, ragged fissure in the convex curve. Length 1·8, breadth at mouth 0·3, at apex 0·07 inch. (*Watson*).

Animal, mantle is white, very thin and transparent; the adductor muscles are short and weak. The liver is small, of a light grayish-brown. The mouth of the mantle is very strong, of a yellowish color, and the animal is rather fawn-colored (*Watson*).

Mid-Pacific, east of Japan, 2050 fms.; *W. of Valparaiso*; 2160 fms. (Challenger).

D. ceras Watson, Journ. Linn. Soc. Lond., xiv, p. 510 (1879). Not *D. ceras* Dall, Bull. M. C. Z., ix, p. 37 (1881); Ibid., xviii, p. 425 (1889); Proc. U. S. Nat. Mus., xii, p. 294 (1890); Bull. U. S. Nat. Mus., No. 37, p. 76 (1884).—*D. keras* Watson, Chall. Rep., p. 3, pl. 1, f. 4 (1885).

"One specimen from mid-Pacific east of Japan is much less curved than the others. That from W. of Valparaiso (distant more than 7,500 miles in a straight line, 4,500 miles north and south and 6,000 miles east and west) is much broader, length 1·7, breadth 0·36 inch, and much more bent, but is obviously identical (*Watson*).

"The distance by sea from the Pacific, off Valparaiso, to the Gulf of Mexico, is so enormous that Mr. Dall's identification of his species with this one seemed to need confirmation, and a specimen was accordingly sent to him for comparison. Mr. Dall sent me a sketch of his solitary specimen with the following remarks, which his sketch confirms: "Yours is older, has lost much tip, and widened at the mouth; the tip is, perhaps, slightly more curved. The sculpture in mine, perfectly preserved, is a little more clearly cut than in yours,

but otherwise identical. Mine was dead and surface not glossy, yours living (though eroded), and in places quite glossy. If the two had been dredged together I think no question would have arisen as to their being the same. From such different localities there is always more doubt, though, in these abyssal things without much reason for it. Mine has no notch, but I find such differences in this character in the same species that I put no value on it unless it is uniform in many specimens. There do not seem to be any other differences. After a most careful scrutiny, I think there are no specific or even definable varietal differences between them."

"This (*D. ceras*) compared with *Dentalium amphialum* Wats. is more curved; the longitudinal striæ are much narrower, more distinct, and more persistent. Than *Dentalium grande* Desh. this is much smaller and especially shorter and stumpier form, without the regular circular lirae, and the longitudinal ribs are much weaker and are closer set. Compared with *Dentalium capillosum* Jeffr., which it superficially resembles, it differs in texture, form and sculpture (*Watson*).

The specimens from the Atlantic reported as *D. ceras*, we refer to *D. candidum* var. *meridionalis*, young.

D. ÆGEUM Watson. Pl. 20, fig. 27.

Shell long, conical, finely tapering, much and very equally bent, though less, of course, as the shell grows larger; thin, pure white, porcellanous, a little chalky towards the mouth, but higher up brilliant. Sculpture: Longitudinal ridges 30 to 35, unequal, rounded above, close, rather high, narrow, and parted by furrows which equal the ribs, but lower down these ribs become broader and flatter, and the furrows widen, till, towards the mouth, the surface becomes uniform and the ridges are only indicated by the faint striæ of the furrows. Under a lens the whole surface shows a faint longitudinally striated texture. On the upper part of the shell the striæ of growth are very faint, but they become rather strongly marked towards the mouth. Toward the apex the outer layers for half an inch are stripped off and leave exposed the brilliant, smooth core, presenting many longitudinal facets corresponding with the ridges of the outer layer. There is an irregular short fissure with broken edges at the apex on the convex curve. Length 2·5 in., breadth at mouth 0·3, at apex 0·33 inch (*Watson*).

Off London River, Kerguelen Island, in 110 fms. (Challenger).

D. ægeum Watson, Journ. Linn. Soc. Lond., xiv, p. 509 (1879); Challenger Rep., p. 2, pl. 1, f. 2.

Than *D. capillosum* Jeffr. this is more conical, more curved, the ridges are fewer, and the furrows between much wider and more open (*Watson*).

D. opacum Sowerby.

Shell nearly straight, attenuated at the apex, its diameter increasing much more rapidly than in the other species; with 17 or 18 rather blunt longitudinal ribs, with a smaller one between each; all the ribs nearly obsolete at the wider extremity; posterior fissure short, dorsal. Length 2·25, diam. 0·3 inch (*G. B. S.*).

From South Sea ships, supposed New Zealand (G. Humphrey's coll.).

D. opacum G. B. S., Zool. Journ., iv, p. 198 (1828).

A few specimens were preserved in Mr. G. Humphrey's collection with the following label: "White striated elephant's teeth, per S. Sea ships, supposed New Zealand" (*G. B. S.*).

D. zelandicum Sowerby. Pl. 6, fig. 81.

Shell white, banded with pale gray and tawny; slightly arcuate, pyramidal, wide. Ribs numerous, but little elevated and unequal. Apex slightly slit (*Sowb.*). Length 57, greatest diam. 8 mill. (from fig.).

New Zealand (B. M.).

D. zelandicum Sowb., Thes. Conch., iii, p. 101, pl. 223, f. 13 (1860); Conch. Icon., xviii, pl. 2, f. 8 (1872).

Very similar to *D. rectum*, but the sculpture is far less bold and coarse (*Sowb.*).

The length is about 7 times the diameter. *D. pacificum* Hutton, in which the length is 8 times the diameter, and *D. huttoni* Kirk, with the length about six times the diameter, are somewhat similar ribbed species, the former perhaps identical. *D. conicum* Hutton, of the New Zealand Pliocene, seems also to belong to this immediate group. Compare also *D. opacum*.

D. pacificum Hutton.

Shell solid, tapering, slightly curved, longitudinally grooved; grooves unequal, about 30 at the anterior end, but diminishing in number toward the apex; white. Length 2·4; breadth, anterior end 0·3, posterior end 0·05 inch=60, 7·5 mill. (*Hutton*).

New Zealand (Hutton).

D. pacificum HUTTON, Catal. Mar. Moll. N. Z., p. 5 (1873); Manual N. Z. Moll., p. [130] (1880).

It is very likely the same as *D. zelandicum* Sowb., as Hutton surmises.

D. HUTTONI Kirk.

Shell white, lustrous; small, curved, rapidly tapering; ribbed, ribs unequal, about 18 at the anterior end but diminishing in number towards the apex. Length 0·63, breadth at anterior end 0·1 inch =15·75, 2·5 mill. (*Kirk*).

Wellington, New Zealand.

D. huttoni KIRK, Annals and Mag. Nat. Hist. (5), vi, p. 15 (July, 1880); Trans. N. Z. Institute, xii, p. 306 (May, 1880).

Three specimens from the stomach of a trumpeter (*Latris hecateia*).

D. AMPHIALUM Watson. Pl. 8, fig. 37.

Shell long, conical, nearly straight, what curve there is very equal throughout, of a dirty brownish-yellow, chalky on the surface, porcellanous beneath. Both specimens are very much eroded, especially on the convex curve, and show a prodigious number of layers of shell, which is, however, thin and slight. There is a short, irregular anal fissure on the convex curve. Sculpture: There are about 50 very slightly raised, rounded, longitudinal ridges, the furrows between which are very much like the ridges reversed, being very shallow and open. These vary a good deal at different parts of the shell, and tend to disappear toward the mouth; they are crossed by fine, close-set, sharp, but very superficial, irregular scratches, which run elliptically round the shell, advancing on the concave and retreating on the convex curve. As the shell grows, these lines of growth become harsh and broken. Length 2 inches, nearly; breadth ·3, nearly; least length 0·05 inch. (*Watson*).

Animal small for the shell, of a pale, ruddy color, which is deeper and browner on the foot and liver, the latter very large: two large masses of long, fine, equal captacula fill the mantle cavity; they spring from the front of the pedestal out of which the buccal mass and the foot arise, and of these, two large bunches project through the mantle orifice; buccal palps very small (*Watson*).

Off mouth of La Plata River, 1900 fms. (Challenger).

D. amphialum WATSON, Journ. Linn. Soc. Lond., xiv, p. 510; (1879); Challenger Rep., p. 3, pl. 1, f. 3.

This species is somewhat like *D. zelandicum* Sow., from New Zealand, British Museum, but in form is much stumpier, the ridges are closer and the shell thinner. Than *D. grande* Desh., "Japan," British Museum, it likewise is stumpier in form; the ridges are less strong, the furrows less marked, the circular striæ less sharp; in *D. amphialum* the longitudinal ridges die out, while in *D. grande* they continue equally strong (*Wats.*).

D. CANDIDUM Jeffreys. Pl. 15, figs. 39, 40; pl. 8, figs. 27, 28, 29, 30.

Shell rather large and solid, the earlier third or half moderately curved, the remainder nearly straight: of a drab or ashy-gray color, the young sometimes brilliant white; glossy. Sculpture, of numerous (44–48) low, rounded and rather flattened riblets parted by impressed linear grooves; toward the apex the riblets or striæ become higher, narrower and parted by intervals as wide as themselves, and toward the aperture the riblets become lower and nearly or wholly disappear; oblique, irregular, sinuously circular growth-lines replacing them. Aperture decidedly oblique and nearly circular. Apex small, with circular orifice, simple or with a slight encircling ledge and a notch or slit on or near the convex side.

Length 74, diam. at aperture 8, at apex 1 mill.

Length 76, diam. at aperture 9, at apex 2 mill.

Length 88, diam. at aperture 10 mill.

Northern and eastern Atlantic and Bay of Biscay, 410–1750 fms. (Valorous Exped.); *west of Ireland*, 664–1476 fms. (Porcupine Exped.); *Western Atlantic from off Nantucket southward to the Carolina coast* in 843–1309 fms. (U. S. Fish Commission); *Gulf of Mexico near Jamaica, etc.; southern west Atlantic, 240 miles E. of Rio Janeiro*, 641 fms.; *90 miles N. of Ceara, Brazil*, 1019 fms. (Albatross).

D. candidum JEFFREYS, Ann. Mag. N. H. (4), xix, p. 153 (1877); P. Z. S., 1882, p. 658, pl. 49, f. 2; Proc. Roy. Soc. London, xxv, pp. 184, 191, 199, no description (1876).—DALL, Bull. M. C. Z., xviii, p. 422; Bull. U. S. Nat. Mus., no. 37, p. 76 (1889); Proc. U. S. Nat. Mus., xii, 1889, p. 294 (1890).—*D. solidum* VERRILL, Trans. Conn. Acad., vi, pp. 215, 276, 283, pl. 44, f. 16, (1884). Not *D. solidum* Hutton, 1873.—*D. ceras* DALL (not of Watson), Blake Gastropoda, in Bull. M. C. Z., ix, p. 37 (1881); xviii, p. 425 (1889); Proc. U. S. Nat. Mus., xii, p. 294 (1890).

Dall has already announced the specific identity of *D. candidum* Jeffr., *solidum* Verrill and *ergasticum* Fischer. Jeffreys' specimens of *D. candidum* prove on comparison to be absolutely the same as the young *D. solidum* Verrill, though the snowy whiteness of the original specimens, with their rather narrower, sharper riblets as in all young shells of the species, give them a different aspect at first view from the drab or ashen, obsoletely sculptured adult shells dredged in American waters. The glistening white color is probably due to local conditions; Dall remarks: "Under favorable circumstances this species may be of a most brilliant milk-white, but nearly all the specimens are dull ashy-gray in color, even when living and in perfect order. I suppose the white ones are those which happen to live in pure sand, while the ordinary form comes from mud or ooze." The young of one lot collected by the "Albatross" 240 miles E. by S. of Rio Janeiro, are as pure white as Jeffreys' types.

Var. MERIDIONALE Pilsbry & Sharp. Pl. 15, figs. 32, 33, 34.

Off Brazil the shell becomes larger and still more solid, the striæ more numerous (90 or more), and they *persist to the aperture*, not becoming obsolete on the later portion of the tube. The aperture is more or less compressed between the convex and the concave sides. Specimens measure:

Length 101, diam. of aperture, transverse, 12·8, longitudinal 12·3 mill.; length of slit 3 mill. (type, no. 87,557 U. S. Nat. Mus.).

Length 108, diam. of aperture, transverse, 14 mill. (off Rio Janeiro).

Length 110, diam. of aperture, transverse, 11, longitudinal 10 mill. (near Jamaica).

The specimens from near Jamaica and from off Cape Fear are to some extent intermediate, but nearer to the variety than to typical *D. candidum* (*solidum*). In our opinion the Atlantic shells referred to *D. ceras* Wats. by Dall are the young of this large southern race of *D. candidum*. Figures 33 (enlarged) and 34 (natural size) show the variation in development of the apex. We repeat here the original description of *candidum*.

D. candidum Jeffreys. Pl. 8, fig. 29, 30.

Shell having the shape of a narrow funnel, tapering, slightly curved, rather thin, opaque, more or less glossy. Sculpture, about forty fine and regular rounded longitudinal striæ, which disappear

towards the front margin; these striæ are crossed by extremely numerous and close-set circular microscopic lines. Color, glistening white. Margin at the anterior or broader end jagged, at the posterior or narrower end abruptly truncated; there is no notch, groove, slit or channel. Length 1·75, diam. 0·3 inch.

Body whitish, with a faint tinge of brown; mantle very thin, forming a collar, which encircles the inside of the upper part of shell; tentacles very numerous, with pear-shaped tips, issuing between the mantle and the shell; foot, when at rest, conical, having a semi-circular lobe or flap on each side, so as to give it a tricuspid appearance; the lobes are fringed or puckered at the edges (*Jeffreys*).

In *D. candidum* the apical slit varies from a length of several millimeters to none at all. In one shell before us it is on the *side* of the tube. An abnormal specimen collected by the Fish Commission is bent spirally, the torsion amounting to about 80°.

Compared with *D. capillosum* this species is more glossy, more curved, with the grooves between the striæ far less impressed, comparatively superficial.

Figs. 27, 28, of Pl. 8, are copies of Verrill's illustrations of *D. solidum*. The figures on Pl. 15 were drawn from northwest Atlantic specimens dredged by the U. S. Fish Commission.

D. ERGASTICUM Fischer. Pl. 15, figs. 35, 36.

Shell large, thick, conic, little curved, white usually encrusted with ferruginous substance; posterior end very acute, exteriorly costulate striate all around, striæ close, about 40 in the region of the slit, acute, narrow, prominent; becoming flat in the middle of the shell, and at the aperture obsolete; the growth-striæ stronger near the aperture. Slit linear, long, on the convex side. Aperture exactly circular, little oblique, ivory-like and thick inside. Length 91, diam. of aperture 10, length of slit 15 mill. (*Fischer*).

Gulf of Gascony and Atlantic, in 400–1900 meters (Travailleur and Caudan Exp.).

D. ergasticum FISCHER, Journ. de Conchyl., 1882, p. 275.—LOCARD, Rés. Sci. de la Campagne du "Caudan" dans le Golfe de Gascogne, fasc. i, p. 170, pl. 6, f. 1, from Ann. de l'Univ. de Lyon (1896).

According to Locard the riblets in fully adult *D. ergasticum* are visible the entire length of the shell from apex to aperture, and the

slit at the apex is longer than in *D. capillosum*, in which, moreover, the sculpture is obsolete toward the aperture. The same author recognizes a var. *major* attaining the length of 113 mill. We have seen some hundreds of specimens of *D. candidum* and a number of *D. capillosum*, none with so long a slit as is indicated for the *D. ergasticum*, specimens of which we have not seen. Pending full comparisons of Fischer's shell with the earlier described forms, it may be best to let it stand as a species, although the mere length of the slit is generally a variable character and of correspondingly minor importance. Fischer's original diagnosis does not agree fully with Locard's remarks. The figure of our plate, copied from Locard, evidently belongs to his var. *major*, though this is not stated in his text. It shows an elliptical section, while *ergasticum* has the aperture "*exacte circularis*." Compare *D. capillosum* var. *paucicostatum*.

D. MILNEEDWARDSI Locard.

Shell of large size, of conoid, very elongate form, stout, arcuate above; base exactly circular, quite oblique, the tube adjacent to it nearly cylindrical and straight as far as the middle, then tapering and arcuate, the greater part of the concavity in the upper three-fourths of the total length. Summit quite thick, very rapidly tapering; apical slit small, rather wide. Shell very thick, very solid, ornamented throughout its length with quite strong, quite regular, flat, compressed longitudinal ribs, separated by simple striæ which are narrow but deep. Growth-striæ sloping, weak, a little more marked toward the base. Coloration a nearly lusterless light red. Length 82, greatest diam. 12, curvature 3 mill. (*Locard*).

West coast of Africa, off the Soudan, in 1435 meters.

D. milne-edwardsi Locard, L'Échange, Revue Linnéenne, No. 146, Feb., 1897, p. 10.

D. SEMIVESTITUM "Fischer" Locard.

Shell very large, of slender form, very narrowly conoid, very attenuated, subcylindrical for the first two-fifths from the base, thence slowly tapering to the apex; nearly straight or very feebly arcuate in the cylindrical part, with a stronger curvature along the latter moiety of the length, summit slowly and progressively tapering. Base obliquely truncate and almost exactly circular; apical slit extremely short, formed simply by a notch. Shell somewhat thin, solid, a little glossy, ornamented nearly the entire length by very

narrow longitudinal ridges, not quite regular nor much projecting, with slightly narrower intervals between them, all much attenuated at the base, sometimes with the ribs narrower and more separated at apex; concentric growth-striæ little marked, visible especially toward the base. Coloration, a yellowish-white with narrow brown rings, more or less continuous, and a wide band of very deep chestnut at the base. Length 75, greatest diam. 5, curvature 5 mill. (*Locard*).

The Tropics and the Sahara, in from 830 to 1113 meters.

D. semivestitum P. Fischer, LOCARD, L'Échange, Revue Linnéenne, xiii, No. 146, Feb., 1897, p. 9.

D. COMPLEXUM Dall. Pl. 20, fig. 25.

Shell large, solid, thick, normally white (?), but discolored by sediments after death, so that the specimens received are a pale, rusty brown; surface glossy, sharply grooved; with wider, flat interspaces, varying finer or coarser in different specimens; orifices circular, one specimen showing indications of a wide, shallow ventral sinus at the apex; shell little curved, and the sculpture shows no rotary tendency. Length of shell 78, diameter anteriorly 8·5, posteriorly 1·3, maximum divergence from a chord connecting the extremities 8·5 mill. (*Dall*).

Off Honolulu, Hawaiian Is., 295–298 fms. (Albatross).

Dentalium complexum DALL, Proc. U. S. Nat. Mus., xvii, 1895, p. 686, pl. 26, f. 3.

This species is most nearly allied to *D. candidum*, but it has more deeply engraved striæ, and the tube tapers less. Dall writes:

This shell differs from *D. candidum* Jeffreys by being more cylindrical and, so far as my present specimens go, without the long, slender, ventral slit of that species. From *D. ceras* Watson, as figured, it is distinguished by being straighter and less sharply sculptured, besides being much larger, but Watson's specimens were young. With a few specimens it is easy to separate species of *Dentalium*, but if one has numerous specimens from various kinds of bottom the difficulty increases greatly. *D. solidum* Verrill, *D. ceras* Watson and *D. candidum* Jeffreys appear to merge into one another, yet individual specimens appear very distinct when one has not a connecting series. The present species, by its somewhat more cylindrical form, seems sufficiently distinct to be named, but, with that exception, is very closely related to the group of forms above enu-

merated. All the specimens were dead, discolored, and occupied by annelid tenants (*Dall*).

D. CAPILLOSUM Jeffreys. Pl. 8, figs. 31, 32, 33, 34, 35.

Shell very slightly curved, solid and strong, white under a dull gray-brown deposit, lusterless. Sculpture of *fine, even, rounded longitudinal threads, separated by narrow grooves, and roughened by close, rather irregular impressed growth-lines;* the threads *about 65 in number* toward the aperture, most of them continuing to the anal end, varying somewhat in width, but remarkably uniform in appearance. Aperture circular, somewhat oblique, thin-edged. Anal orifice nearly round; slit rather narrow and short, on the convex side. Length 81, diam. of aperture 8·6, of apex 1·6 mill.; length of slit 3 mill.

Whole North Atlantic, 208–1785 fms. (Valorous, Porcupine); *off Bahia Honda*, 418 fms.; *Bay of Biscay*, 882 fms.; *N. of Hebrides*, 542 fms.; *Coast of Portugal*, 220–1095 fms.; *W. of Azores and off San Miguel*, 1000 fms.; *Setubal*, 470 fms.; *off Culebra I., W. Indies*, 390 fms. (Challenger); *off Havana*, 119 fms.; *off Martinique*, 169 fms.; *near Santa Lucia*, 116 fms. (Blake); *Barbados*, 100 fms. (Hassler Exped.).

D. capillosum JEFFR., "Valorous" Rep., Proc. Roy. Soc., xxv, 1876, pp. 185, 191 (name only); Ann. Mag. N. H. (4), xix, 1877, p. 153; Ibid (5), vi, p. 375, (1880); P. Z. S., 1882, p. 658, pl. 49, f. 1.—WATSON, Challenger Rep., p. 1, pl. 1, f. 1.—DALL, Blake Moll., Bull. M. C. Z., xviii, p. 425; Bull. U. S. Nat. Mus., no. 37, p. 76 (1889).

The above diagnosis and fig. 33 are from specimens dredged near Graciosa, Azores, in 800 fms.

Jeffreys described this species from a young specimen as follows:

D. capillosum Jeffreys, (Pl. 8, figs. 31, 32). Shell tapering to a fine point, slightly curved, rather solid, opaque, and mostly lusterless. Sculpture, numerous and sharp (not rounded) longitudinal striæ, some of which are intermediate and smaller than the rest; they disappear toward the posterior or narrow end, which is quite smooth and glossy for one-quarter of an inch; color whitish; margin at the posterior end having a short and narrow notch; length 1·4 inch, breadth 0·15 inch. (Jeffreys, 1877).

Dr. Gwyn Jeffreys has described the ribs as "sharp (not rounded)." They rather seem to be sharply cut, but they are rounded on the

top. Length 2·1 inch, breadth at mouth 0·22, at apex 0·036 inch.

The young specimen from off Azores has at the apex on the convex curve a slit 0·1 inch long, but interrupted by two bridges of the shell which have not been removed when the fissure was made (pl. 8, fig. 34).

From off the Azores the specimens belong to the typical form; that from Setubal, a remarkably large and fine specimen, belongs to a variety:

D. CAPILLOSUM var. PAUCICOSTATUM Wats., with only about 40 instead of 65 longitudinal riblets or threads, which are very flat on their top and are divided by furrows remarkably broad and square in form. These differences strike one very strongly at first, but the transverse sculpture is identical, and there are spots on the typical specimens which present an exactly similar form of ribbing. Figs. 35. (*Watson*).

"All the Blake specimens were dead or fragmentary, and most of them belong to the variety *paucicostatum* Watson. In examining the specimens named *D. capillosum* in the Jeffreys collection, I find several of them which he regarded as the young to be of a more slender and much smaller species, which probably never attains a large size, though sculptured like *D. capillosum*. The specimen figured in the P. Z. S. above cited, is only about one-third the size of an adult." (*Dall*).

D. MAGNIFICUM E. A. Smith.

An Indian Ocean species resembling *D. capillosum*, but with decidedly coarser striation and longer slit. Aperture circular. Length 101, diam. 13·4, length of slit 6·5 mill. It is known to us from a specimen in the U. S. National Museum. So far as we can learn, no description has yet been published.

D. EXUBERANS Locard.

Shell of relatively large size, very strongly conoid contour, very wide at the base, tapering rapidly at first, then more progressively to the summit; profile at first straight, but quite conic for a short distance from the base, becoming more curved further up, but always quite moderately arcuate. Aperture very oblique, a little undulated, visibly oval, contracted toward the dorsal, widened toward the inner curve. Summit quite slender, rapidly tapering; apical slit elongated, ordinarily constituted of a series of narrow and successive orifices, more or less regular. Shell quite thin but solid,

ornamented throughout its length with well developed unequal ribs, rather narrow and nearly rounded on the dorsal surface, wider and perceptibly flattened on the opposite surface, the interspaces a little wider than the ribs. Growth striæ oblique toward the base and quite impressed, spaced and a little irregular, becoming straighter and less visible toward the apex. Color dull gray above, passing into slightly shining white toward the base. Length 95, greatest diam. 17, curvature 10 mill. (*Locard*).

West coast of Africa, Senegal, Sahara, Azores between Pico and St. George, between 1258 and 3650 fms.

D. exuberans LOCARD, L'Échange, Revue Linnéenne, No. 146, Feb., 1847, p. 10.

The slit seems to be interrupted into a series of orifices as in *D. plurifissuratum* and the young specimen of *capillosum* figured by Watson, and the aperture is oval.

D. SCAMNATUM 'Fischer' Locard.

Shell of relatively very large size, the contour narrowly and progressively conoid from base to summit, perceptibly curved throughout the length; base quite wide, with almost exactly circular aperture, the plane of which is a little oblique. Apex slender, contracted, slowly tapering; apical slit narrow and long. Shell somewhat thin, quite solid, ornamented throughout with very fine longitudinal costulations, which are regular, a little flattened, closely crowded and very vaguely subgranulose, the intercostal intervals shallow and very narrow as though linear. Concentric striæ of growth fine, crowded, scarcely regular, giving the costulæ a subgranulose appearance. Color a light reddish-gray, sometimes paler at base. Length 95, greatest diameter 9 mill., curvature 4 mill. (*Locard*).

West coast of Africa, Cape Ghir, the Azores, and Sargasso Sea, in 1235–2087 meters.

D. scamnatum P. Fischer, LOCARD, L'Échange, Revue Linnéenne, No. 146, Feb., 1847, p. 10.

D. PROFUNDORUM E. A. Smith. Pl. 6, fig. 82.

Shell large, solid, lightly arcuate, longitudinally very finely striated and sculptured with oblique growth-lines; dull buff; posteriorly slit. Aperture nearly circular, white inside, thin at the oblique margin and acute. Length 90, greatest diam. 10 mill. (*Smith*).

Off Colombo, Ceylon, lat. 6° 32′ N., long. 79° 37′ E., in 675 fms. (Investigator Exped.).

D. profundorum SMITH, Annals and Mag. N. H. (6), xiv, p. 167, pl. 4, f. 18 (Sept., 1894).

This species rather closely resembles the fossil *D. grande* Deshayes, but the style of the striation is not quite the same, and the form is not quite so slender. The fine thread-like slightly rounded riblets are about eighty in number, and usually rather broader than the intervening striæ. None of the three specimens examined are perfect posteriorly, so it is impossible to describe the fissure properly. In the largest example a mere notch indicates the existence of a slit in the normal position.

In a second specimen there is a distinct lateral fissure 3 mill. in length, but whether this is an accidental fracture is not quite certain. The surface of this species appears to be subject to erosion, for patches are broken away here and there throughout the entire length of the shell.

D. capillosum Jeffreys, is a closely allied species from the Atlantic, but somewhat more slender in form and not quite similar in sculpture. (*Smith*).

D. VERNEDEI "Hanley" Sowerby. Pl. 3, figs. 35, 43.

Shell gently curved, solid, whitish, with or without some pale yellowish zones, lusterless. Sculpture, about 40 rounded, longitudinal riblets on the larger portion of the shell, most of equal size, and parted by interstices narrower than the riblets; but toward the apex the riblets become alternately small and large; growth-striæ close, fine and prominent. Aperture circular, at nearly a right angle with tube. Anal orifice circular, with a deep and rather wide slit on the convex side.

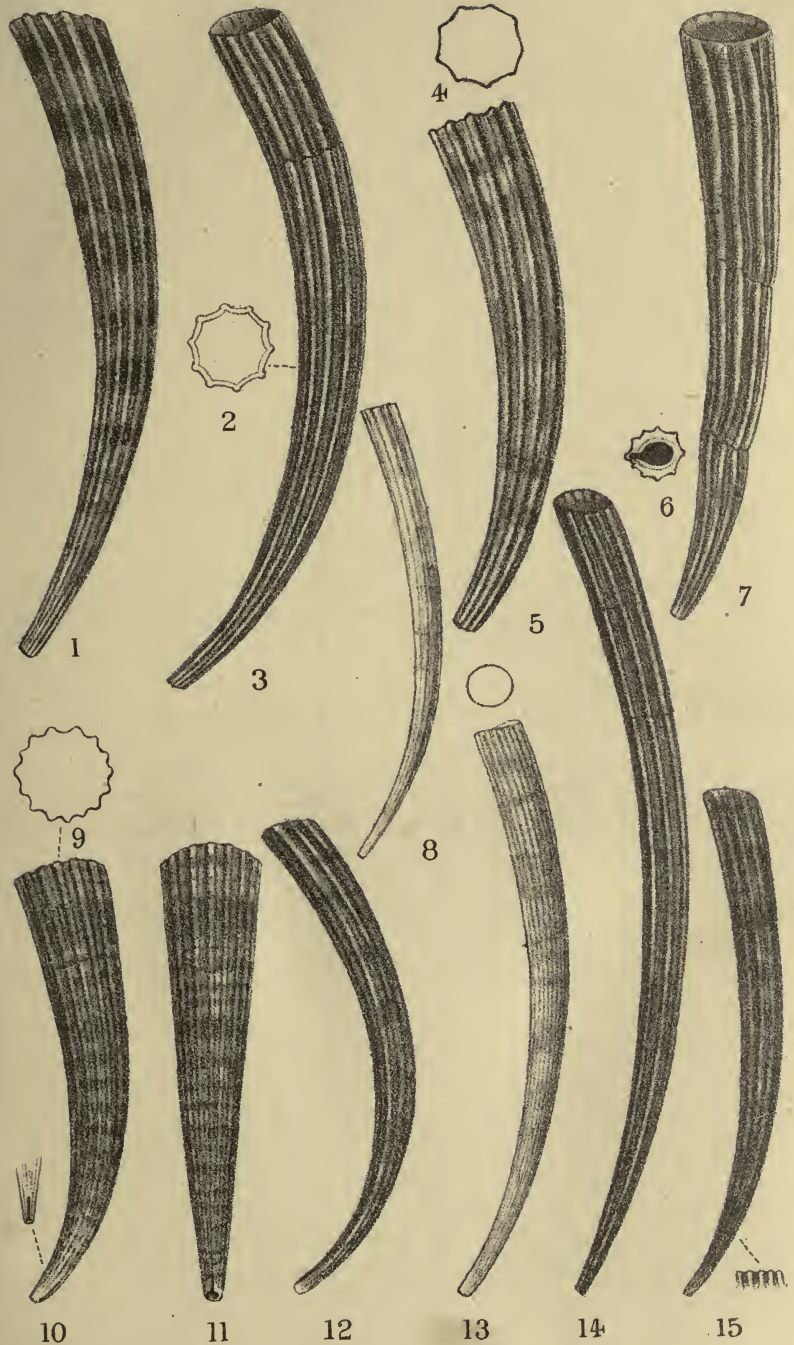
Length 90, diam. of aperture 11, height of arch above chord 12–13 mill. (specimens).

Length 133, diam. 15 mill. (Dkr.).

Japan (McAndrew coll.; Dunker); *China* (Garrett).

D. vernedei Hanley, SOWERBY, Thes. Conch., iii, p. 101, pl. 223, f. 3 (1860); Conch. Icon., xviii, pl. 1, f. 3 (1872).—DUNKER, Index, Moll. Mar. Jap., p. 153 (1882).—"*Antalis verendi* A. Ad.," CLESSIN, Conch. Cab., p. 26.

This species is more curved and more slowly increasing than *D. rectum*, and has the riblets subequal except toward the apex.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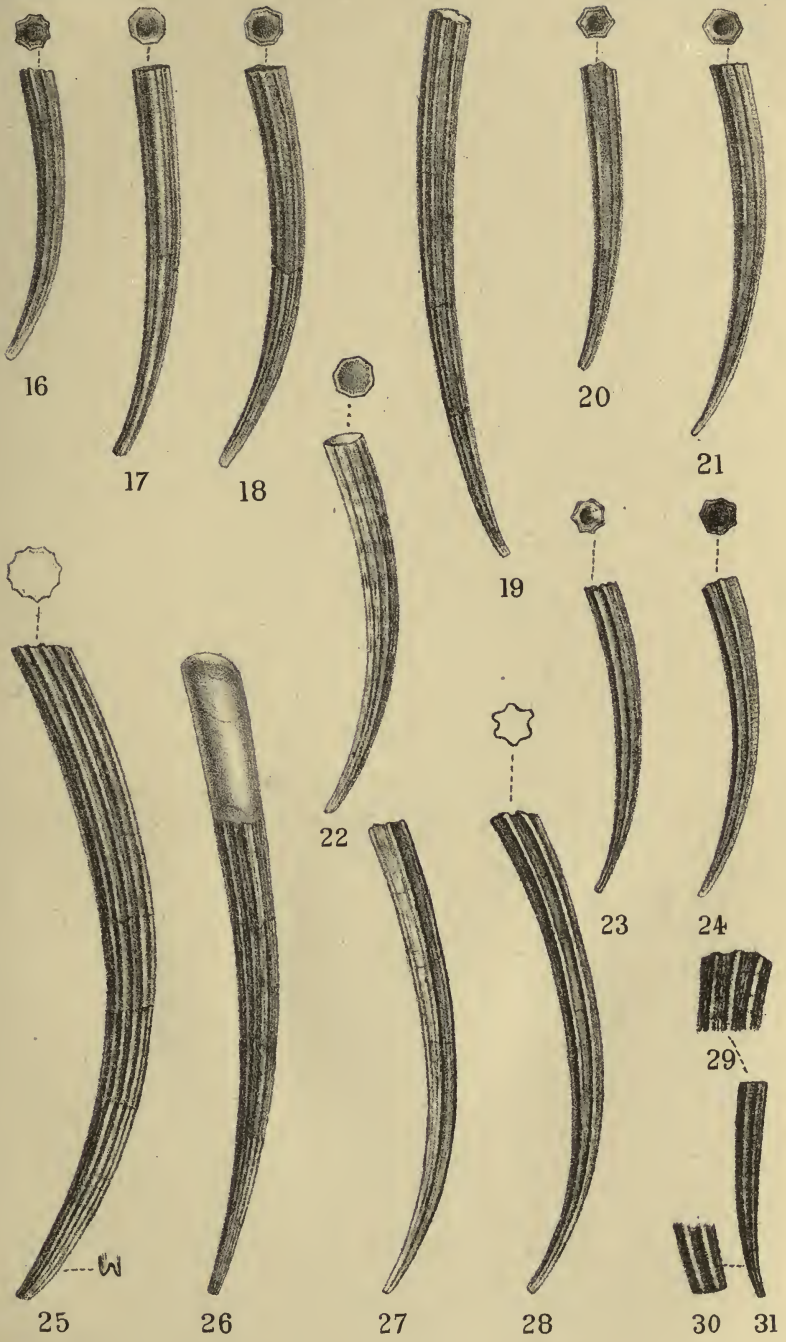
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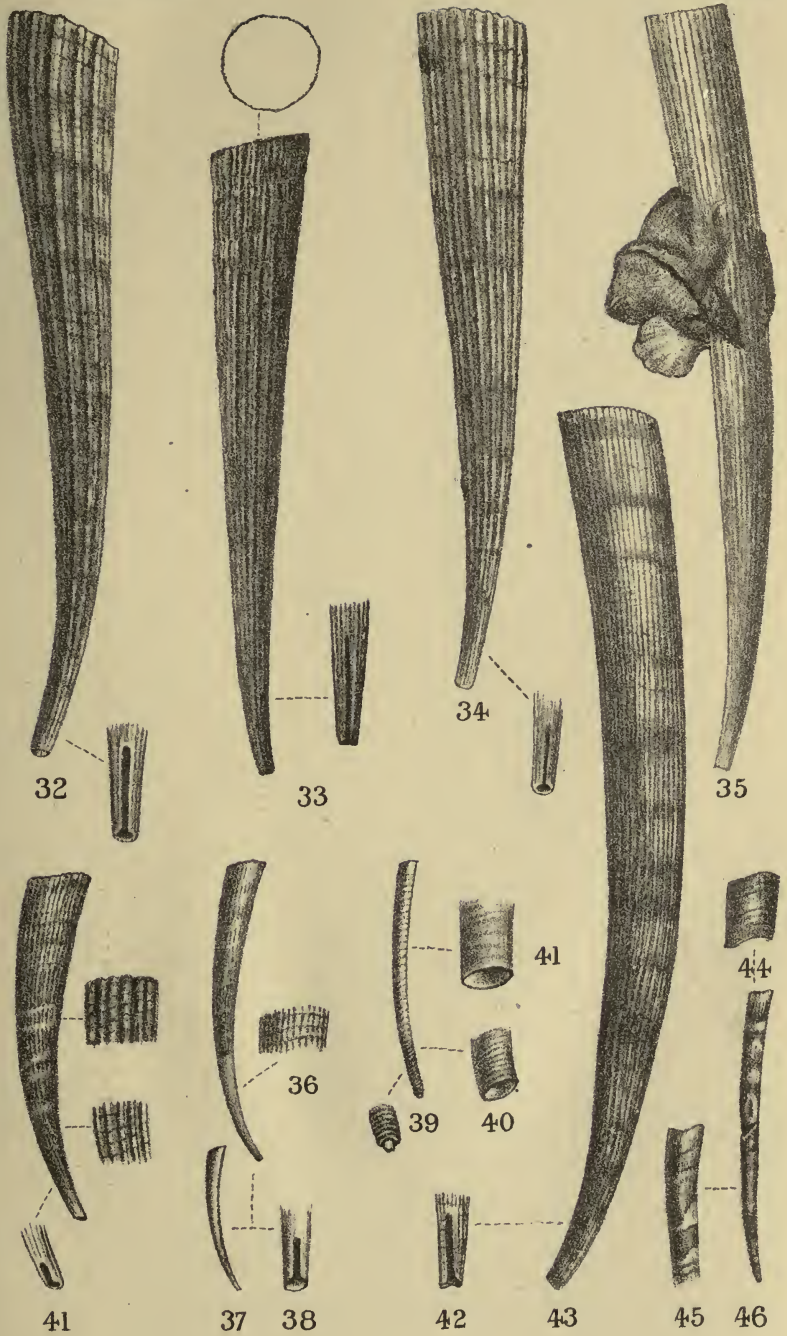
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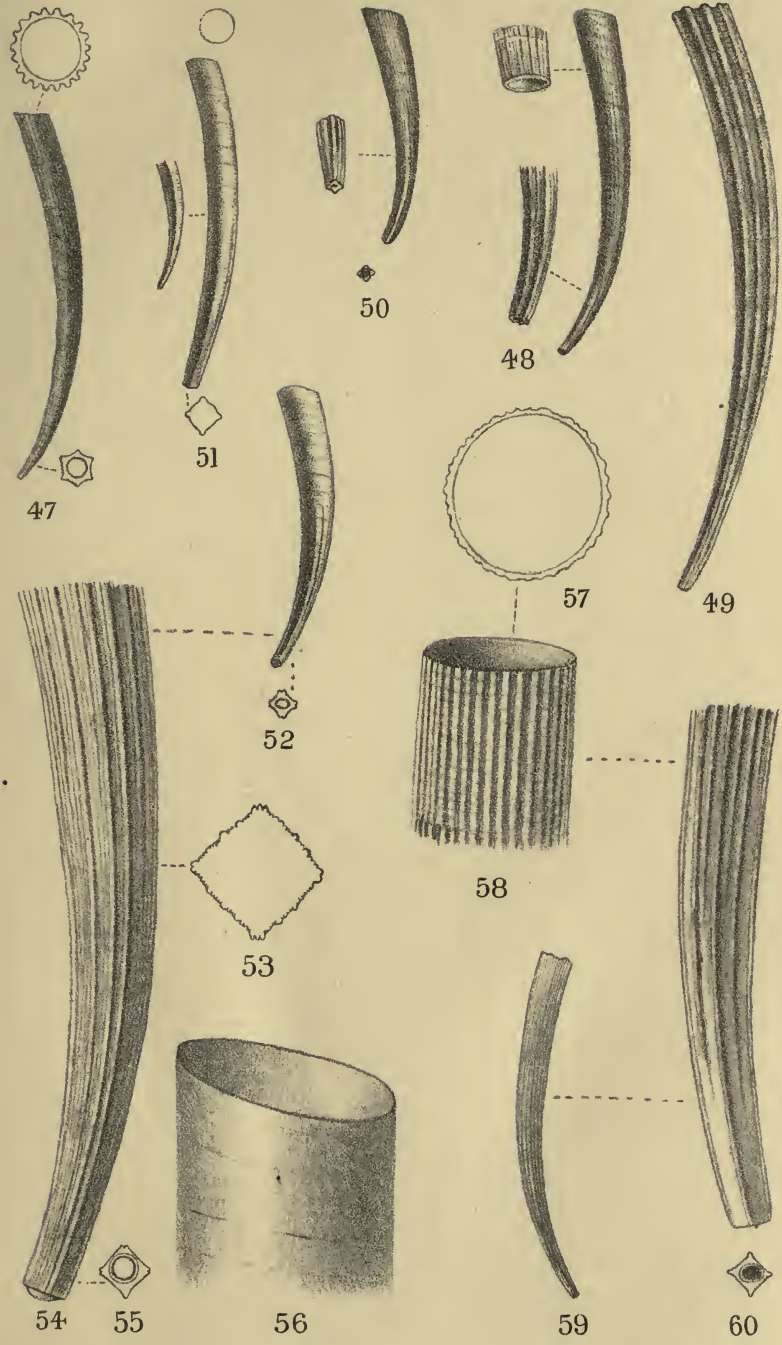
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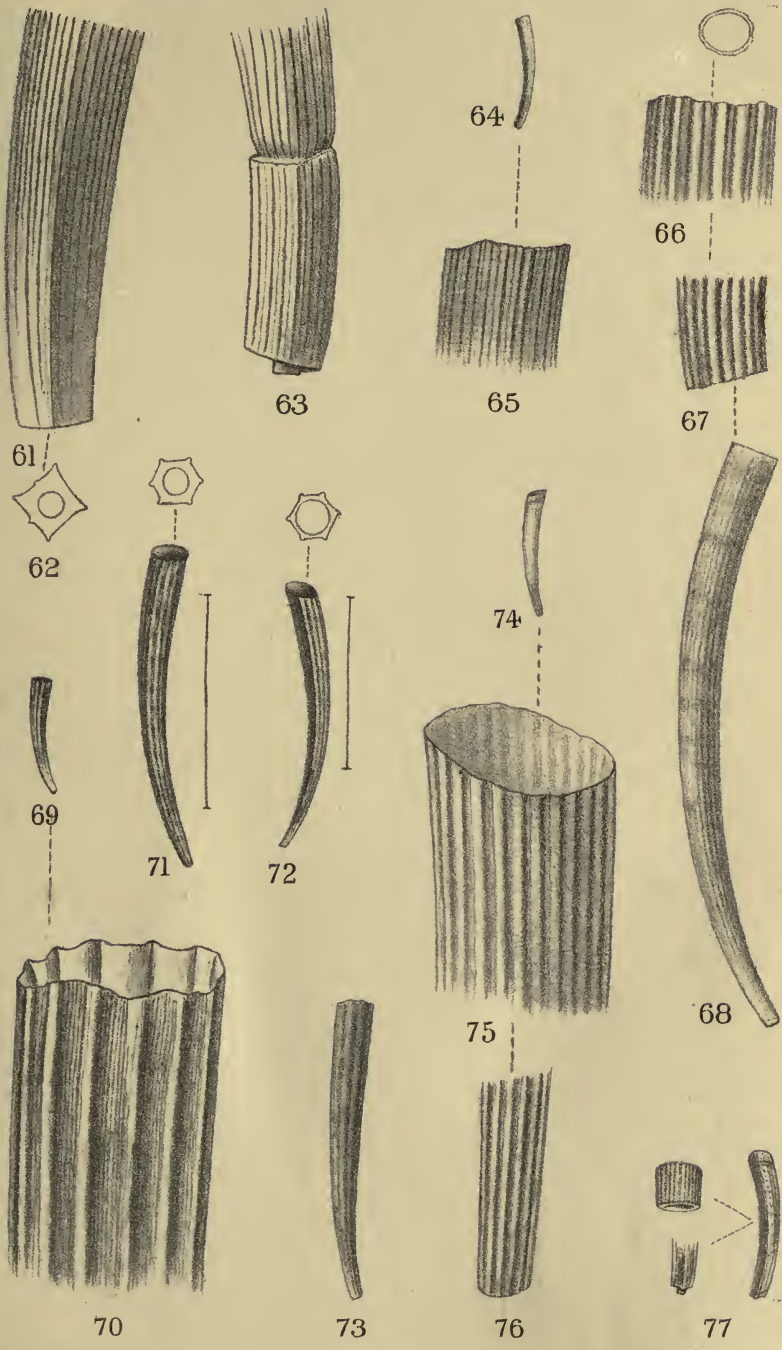
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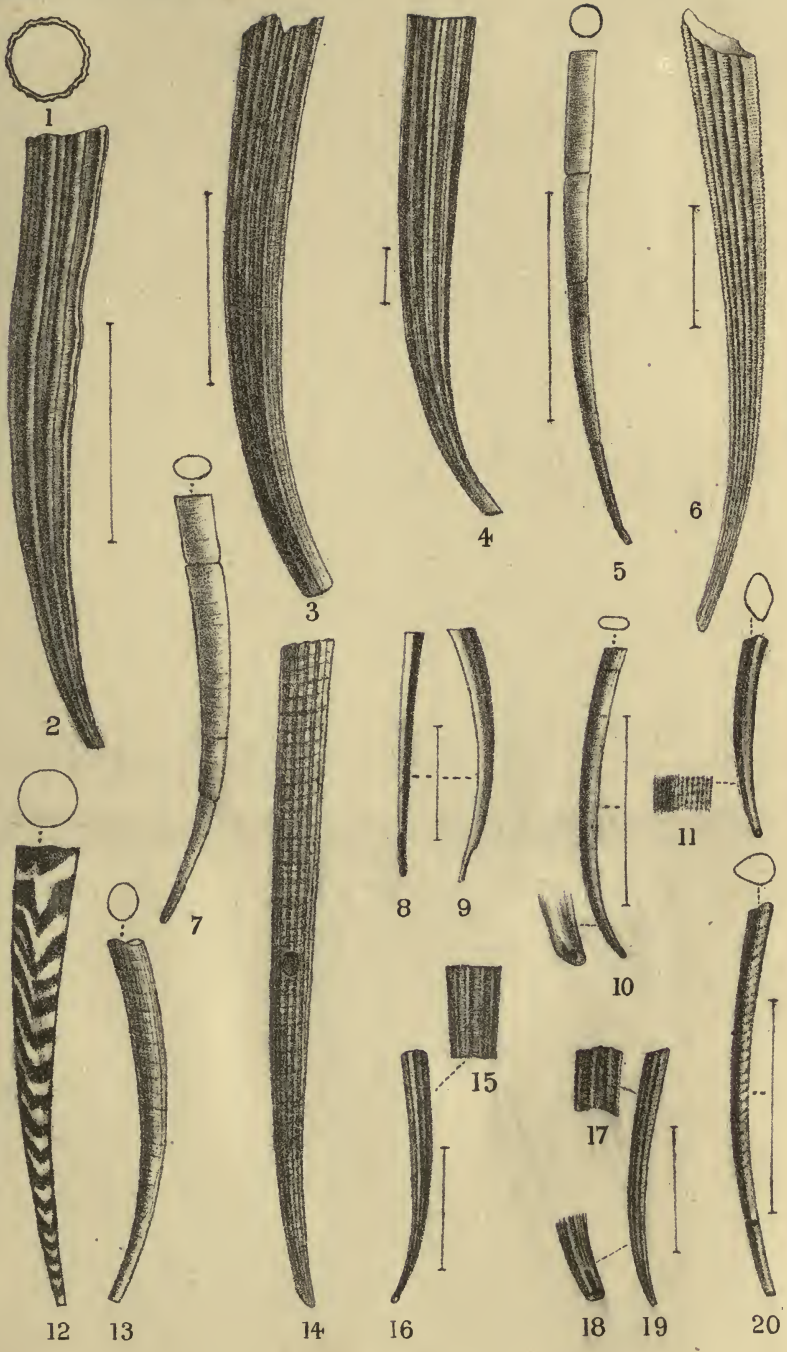
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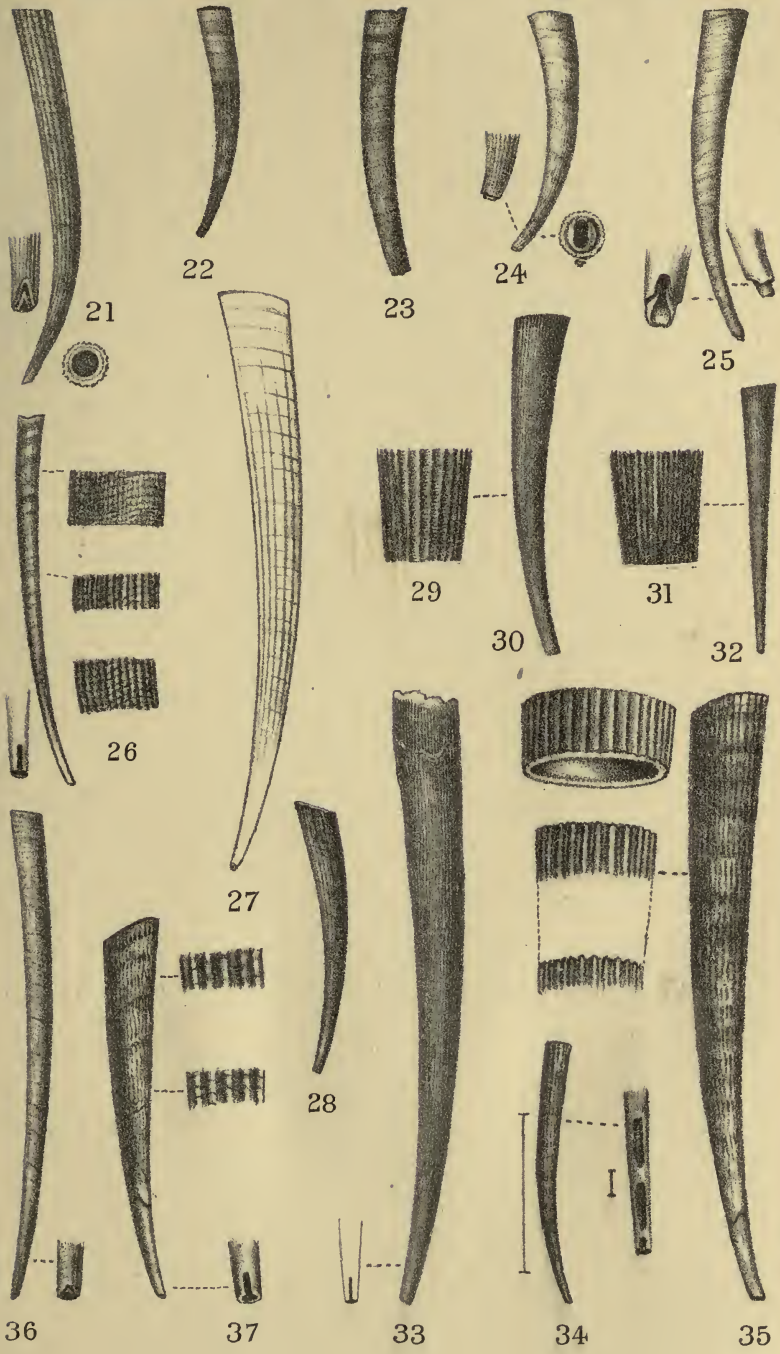
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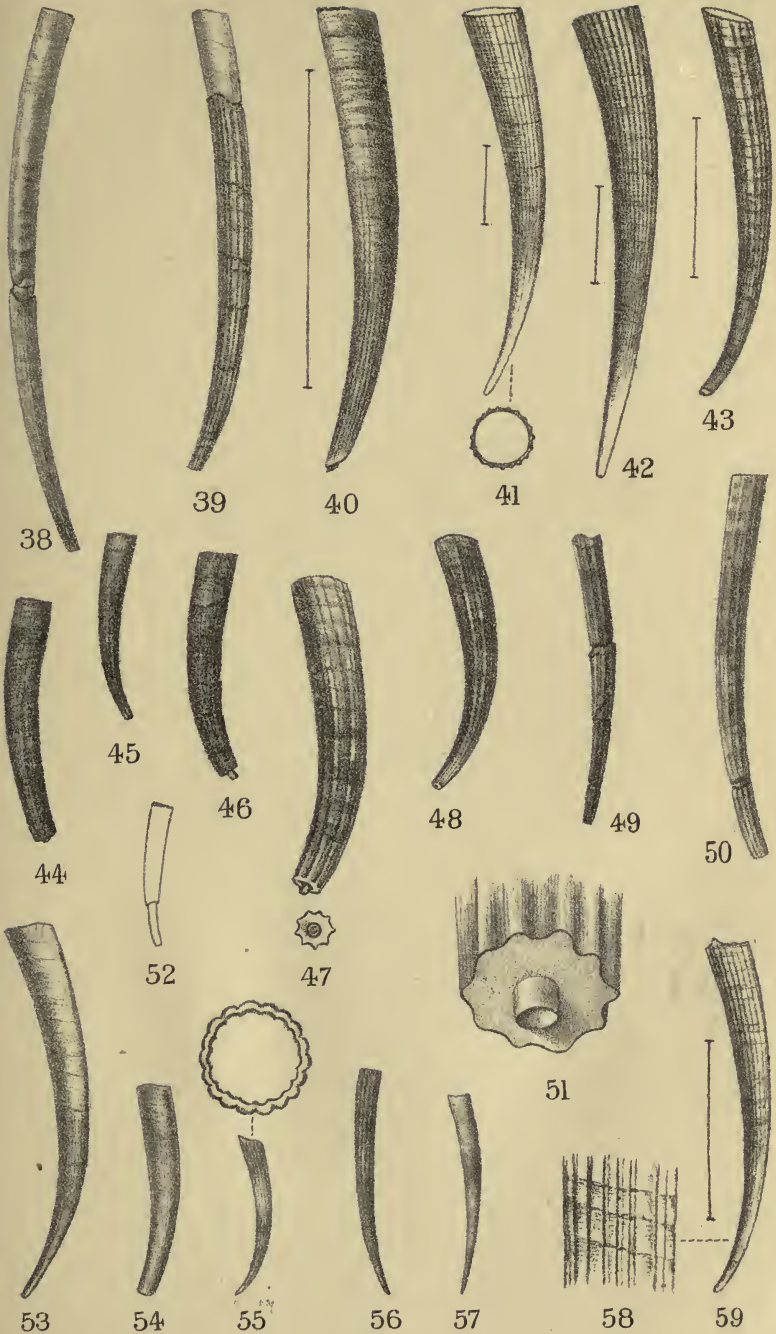
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One specimen before us (fig. 35) has no slit, there being only a slight notch on the inner margin of the anal aperture. It measures, length 94, diameters of aperture 10·3 mill. In another shell 90 mill. long the slit has a length of 7·6 mill.

D. RECTUM Gmelin. Pl. 3, figs. 32, 33, 34.

Shell nearly straight, slightly curved toward the anal end, solid, whitish, with faint, wider, grayish zones, lusterless. Sculptured at the anal end with about twelve larger alternating with an equal number of smaller, rather high, narrow and sharply cut ribs; this number being increased toward the larger end by the intercalation of numerous tertiary longitudinal riblets and striæ; the whole surface very densely and finely microscopically striate in a longitudinal direction, and decussated by equally fine incremental striæ. Aperture quite oblique, circular, thin-edged. Anal orifice small, circular, with a long, narrow slit on the convex side. Length 63½, diam. of aperture 12½ mill.

India (Desh.).

D. rectum GMEL., Syst. Nat. (13), p. 3738 (1788).—WOOD, Index Testac. p. 191, pl. 38, f. 1*d* (1818).—SOWB., Thes. Conch., iii, p. 101, pl. 223, f. 1 (1860); Conch. Icon., xviii, pl. 1, f. 4 (1872).—DELESSERT, Rec. de Coq., pl. 1, f. 3 (1841).—*D. elephantinum* DESHAYES, Mém. Soc. Hist. Nat. Paris, ii, p. 347, pl. 17, f. 7 (1825) exclusive of fossil forms and var. *a*.—*Antalis recta* CLESS., Conch. Cab., p. 25.

The straight form, more rapidly increasing cone and alternating ribs readily distinguish this from *D. vernedei*.

The locality is very uncertain. Sowerby gives "Adriatic," which is certainly wrong, unless, indeed, his figures really represent *D. delessertianum*. We have a specimen said to be from the Gulf of California. Compare *D. delessertianum* Chenu and *D. philippii* Monts. not Chenu.

The identification of this shell with Gmelin's species rests upon his citation of a figure in Gualtier, reproduced with the embellishment of color, and the omission of some of the sculpture, in Martini, and a figure of Schröter's which seems to represent a crinoid stem. While there is some doubt of the identity of *D. rectum* of modern authors with that of Gmelin, it seems inadvisable to change.

D. DELESSERTIANUM Chenu. Pl. 6, figs. 78, 79.

Shell large and solid, the apical third somewhat curved, remainder nearly straight or slightly recurved. Sculpture of 13–14 high,

rather acute ribs at the apex, becoming rounded anteriorly, and either splitting to form about three minor riblets, or not noticeably divided but having several strong longitudinal cords developing in each interval; all longitudinal sculpture subobsolete near the aperture, where growth-striæ predominate in old individuals. Aperture circular, quite oblique. Anal orifice with a slight sheath (as in *entalis*) and a long, usually crooked slit.

Length 111, aperture 14 x 14 mill., slit 12 mill. long (old specimen).

Length 99, aperture 13 x 13 mill., slit 19 mill. long (hardly mature).

Living, in Eastern Atlantic (Travailleur Exped.); *Pliocene of Monte Pellegrino, Sicily, Rhodes, etc.*

D. delessertianum CHENU, Illustr. Conch., i, Dentalium, p. 3, pl. 6, f. 10.—FISCHER, Journ. de Conchyl., 1882, p. 276.—*D. delesserti* CHENU, Manuel de Conch., i, p. 374 (1859); also *Dentale de Delessert*, Leçons Elém. d'Hist. Nat., p. 141, f. 448 (1847).—*Cf.* also FORESTI, Bull. Soc. Mal. Ital., xix, pp. 240, 242.—*D. elephantinum* and *D. rectum* of many writers on Pliocene fossils of the south of Europe.

Our diagnosis is from Monte Pellegrino Pliocene specimens. Chenu's description is as follows:

Shell very large, multicostate, with several small riblets between the ribs. This fossil species is the largest and one of the finest of the genus. It has 10 or 12 large and raised ribs, with 3 or 4 smaller riblets in the intervals; smaller end obliquely truncate and well slit (*Chenu*). Length 114, greatest diam. 13 mill. (from fig.).

The aperture is more oblique than in *D. rectum*. The identity of this species with *D. philippii* Monts. affirmed by DeFranchis and Foresti is somewhat doubtful, but we have not material enabling us to attempt a rectification of the nomenclature of Italian Pliocene and Postpliocene species. The synonymic knots are worse than Gordian, and there are several tied to each species.

D. PLURIFISSURATUM (Sowerby). Pl. 6, figs. 87, 88, 89.

Shell subulate, rather thick, slightly curved posteriorly and attenuated; pale; longitudinally very delicately striated and having many unequal riblets; irregularly roughened circularly. Fissures 2 to 5, the first (near the apex) generally long, the rest shorter. Length 64, greatest diam. 7·5 mill. (*Sowb.*).

Hong Kong?

Schizodentalium plurifissuratum Sowb., Proc. Malac. Soc. Lond., i, p. 158, pl. 12, f. 24 (Oct. 1894).—Simroth in Bronn's Klassen u. Ordnungen des Thier-Reichs, iii, p. 375, f. 45A (1894).

This species is type of the genus *Schizodentalium* Sowerby, characterized by having the shell Dentalium-shaped, the convex side with a longitudinal series of slits in place of the usual fissure, or, in other words, the fissure is interrupted by several bridges of shell.

The conjectured mode of formation of the slits given by Sowerby seems to us inadmissable. They are, in all cases, so far as present knowledge goes, absorbed out of the solid shell-wall, and not left open in the progress of growth as in *Emarginula* or *Haliotis*.

In the present lack of knowledge regarding the physiologic rôle of the slit, the uncertainty as to whether any other character is correlated with it, and the variability of its occurrence in some forms, it seems to us hardly desirable to base a generic distinction upon this one modification. Compare *D. exuberans* Locard, and Watson's remarks quoted under *D. capillosum*, and alluded to below.

Mr. Sowerby further writes of this interesting form as follows:

"The shell is very like an ordinary multicostate Dentalium, but distinguished by the following remarkable character. In a line with the usual apical notch there are several slits on the convex side, extending from the summit to about a quarter of the length of the shell. I have three specimens before me, and the dimensions given above are taken from the largest; it has five perforations, the first being a narrow slit about 2 mill. in length, the second and third rather shorter, and the last two only about ·75 mill. The second specimen is about 47 mill. long, and has five slits which are narrower than in the first, four of them being of nearly equal length. The third specimen is a young one 28 mill. long, having only two long narrow slits. A fourth specimen has been, for many years, in the British Museum unnoticed; it is nearly as large as my largest, and has four slits.

"It is, at present, uncertain how these perforations are formed. It may be conjectured that when young there has been an open slit or notch in the anterior margin, as in *Emarginula*, which has been enclosed in the next stage, as in *Rimula*, a succession being formed and enclosed in subsequent stages.

"The animal is very like that of *Dentalium entalis*, and the Rev. Prof. Gwatkin has examined the radula, finding it the same as in the typical Dentalium.

"I am not quite certain as to the habitat of this curious mollusk; it was not among those dredged by Dr. Hungerford, but I believe the three specimens were found in the neighborhood of Hong-Kong.

"[Since the reading of this paper our President drew my attention to the fact that the Rev. R. Boog Watson, in his Report on the Scaphopoda and Gasteropoda of the Challenger, p. 2, pl. 1, fig. 1b, noticed something on a very small scale approaching the character here described in the case of a very young specimen of *Dentalium capillosum* Jeffreys. He says: "The young specimen from Station 78 has at the apex on the convex curve a slit 0·1 in. long, but interrupted by two bridges of the shell which have not been removed when the fissure was made.]"

D. HUNGERFORDI Pilsbry & Sharp, n. n. Pl. 6, fig. 83.

Shell rather wide, almost straight, acute; unequally *compressed;* toward the apex slightly inclined. Tawny, irregularly banded with brown. Sculptured with very numerous plano-convex unequal riblets, and cancellated by but slightly conspicuous transverse striæ. Slit long and narrow. Aperture somewhat oval. Length 72, greatest diam. 12 mill. (*Sowb.*).

Hong Kong (Hungerford).

D. compressum SOWB., P. Z. S., 1888, p. 569, pl. 28, f. 18. Not *D. compressum* Watson, 1879, nor of Meyer, nor of Orbigny.

A very distinct and remarkable species, more highly colored than its congeners; but it is chiefly distinguished by its curiously compressed form. A second specimen, brought by Dr. Hungerford, is only 62 millimeters in length, and rather wider in proportion. It is rather lighter in color, but presents all the same characters, confirming the specific importance of the chief characteristic, which might otherwise have been thought accidental (*Sowb.*).

Apparently more tapering and more finely ribbed than the large, compressed species of unknown origin described by Chenu as *D. giganteum.*

D. CLATHRATUM von Martens. *Unfigured.*

Shell rather straight, *elliptical in section,* white, opaque, with *about 16 angular, narrow, equal ribs,* with smaller ones sparsely intercalated towards the aperture, the *interstices conspicuously transversely striated.* Apical orifice thick-edged; slit on the convex side, narrow, long. Length 51, transverse diam. of aperture 4, dorso-ventral diam. 3¼ mill., diam. of apex ⅔ mill. (*Mart.*).

Near Moreton Bay, eastern Australia, 550 fms. (Gazelle Exped.).

D. clathratum E. von Martens, Sitzungs-berichte der Gesellschaft naturforschender Freunde zu Berlin, Jahrgang 1881, p. 66, (April, 1881).

Similar to *D. compressum* Watson of the West Indies. The interspaces between the ribs are about three times as wide as the ribs themselves, where smaller riblets are not interposed. (*Martens*).

Subgenus Graptacme Pilsbry & Sharp, 1897.

Surface sculptured with *close, fine, deeply engraved longitudinal striæ near the apex*, the remainder smooth; or rarely the striæ persist half or all the length. Moderate sized or small species, cylindrical in section, and white or nearly so.

Distribution: Antillean and Panamic regions; Indo-Pacific; mainly living in quite moderate depths.

There is remarkable diversity in the characters of the apices in this apparently very natural group. In some species, as *D. semistriatum* and *eboreum*, the apical orifice is perfectly simple; in others, such as *D. aciculum*, a slight notch appears; in *D. leptum* there is a slit on the convex side. *D. sericatum* has the slit *lateral*, and it is on the *concave* side in *D. inversum*. *D. sectum* and *calamus* have the apical aperture reduced to a slit across the summit of a convex apical plug, an altogether peculiar structure.

In old or worn specimens of some species the striation is lost.

I. Apex with simple orifice or variously slit, not contracted, *Group of D. semistriatum.*

II. Apical orifice contracted by a callous plug cleft by a slit from convex to concave side, *Group of D. sectum*, p. 96.

Group of D. semistriatum.

I. No slit at the apex; apical seventh to two-thirds with fine, clear cut incised striæ, the remainder smooth and polished.

a. Length 76 mill., about 18 times the diam.; posterior third striate, *novæhollandiæ*, p. 93.

a'. Length 20–31 mill., 10–12 times the diam., *eboreum*, p. 89; *semistriatum*, p. 90; *semipolitum*, p. 91; *aciculum*, p. 93.

II. An apical slit or notch *on the side;* young zig-zag clouded with opaque white; length 33–35 mill., 9–10 times the diam., *sericatum*, p. 86.

III. An apical slit or notch on convex side only; not zig-zag clouded.

a. 17–20 fine sharp ribs, increasing in number, but becoming faint toward mouth; puckered elliptically; a short slit; length 48 mill., 15 times the diam., *circumcinctum*, p. 88.

a'. Very fine striæ near apex, then smooth; delicate salmon tinted; a deep narrow fissure; length 31 mill., 15 times diam., *leptum*, p. 89.

a''. Striæ fine, faint in adults; long and slim, rather straight; an irregular fissure; length 38 mill., 12–13 times diam., *acutissimum*, p. 94.

a'''. Fine striæ on posterior seventh only; a slight apical notch; length 29 mill., about 11 times diam.; white, *aciculum*, p. 93.

IV. A slit across the apex; length 45 mill., about 12 times the diam., *splendidum*, p. 96.

V. A slit on the concave side; striate near apex only; length 30 mill., about 16 times the diam., *inversum*, p. 95.

D. SERICATUM Dall. Pl. 16, figs. 41, 42, 43, 44, 45, 46; pl. 7, fig. 12.

Shell considerably curved, rather slender, thin; very glossy. Subtransparent, bluish-white, *with numerous finely zig-zag encircling bands of opaque white*, becoming less jagged but still irregular on the larger part of the shell, and generally disappearing toward the aperture. Sculpture of deeply engraved and extremely *fine, close, longitudinal striæ near the apex* (and therefore all over young shells), but *soon disappearing, leaving far the greater part of adult shells smooth* except for faint annular swellings. Aperture somewhat oblique, circular. Anal orifice small, circular, with (in adults) a short slit which is *lateral* (latero-dorsal to latero-ventral) in position, and sometimes represented by an internal channel only.

Length 35, diam. of aperture 3·3, of apex 1·1 mill.

Length 33, diam. of aperture 3·8, of apex 1·2 mill.

Length 38·5, diam. of aperture 4, length of slit 2 mill.

Length 37, diam. of aperture 4, length of slit 2·5 mill.

Length 34, diam. of aperture 3, length of slit 1·2 mill. (immature).

St. Thomas (Swift); *St. Martin* (Marie); *Yucatan Strait* in 640 fms. (Blake).

D. sericatum Dall, Bull. M. C. Z., ix, 1881, p. 37 ; xviii, Blake Moll., p. 423, pl. 26, f. 1 ; Bull. U. S. Nat. Mus., 37, Catal. Mar. Moll. S.-E. U. S., p. 76, pl. 26, f. 1.—*D. semistriolatum var. B*, Guilding, Trans. Linn. Soc. Lond., xvii, p. 34, pl. 3, f. 6 (1834).—*D. nebulosum* Lin., Desh., Mém. Soc. Hist. Nat. Paris, ii, p. 369, pl. 16, f. 20 (1825).—Sowerby, Thes. Conch., iii, p. 98, pl. 225, f. 58 (1860) ; and in Conch. Icon., pl. 7, f. 53 (good). Not *D. nebulosum* Gmelin, Syst. Nat. (13), p. 3738.

Remarkable for the zig-zag white rings of the young, and the position of the slit, which is generally more lateral than ventral, although intermediate between the convex and lateral sides of the shell. *D. cocconii* Sharp & Pilsbry (*D. dispar* Mayer in Cocconi, not Sowb.), has a similar lateral slit. The young are densely striated longitudinally and generally without a slit, and some old specimens have swollen rings as in *D. eburneum*, but slighter.

We do not follow Deshayes' identification of this with Gmelin's *nebulosum*, because the description of that, as well as the locality, indicate a different form. Some authors have referred it to *D. vulgare*. Gmelin's description, which is not elucidated by citation of figures, is as follows:

" *D.* testa arcuata, laevissima, alba, fulvo, maculata, nebulosaque. Habitat in Mari Siculo, *fasciato* affine, ac testa magis arcuata, longiore et tenuiore."

Dall's description of the single specimen dredged by the ' Blake ' is quoted below. We consider it a young shell in which the character of being longitudinally striate throughout would disappear in the adult form. The alternation of translucent bluish with opaque white bands is but poorly represented by the figure, which shows the pattern merely. We have compared the type of *sericatum* with the adult shells described above, and have before us a full series connecting the sharply zig-zagged young form with the ring-clouded adults. The locality given by Deshayes for his *nebulosum* is incorrect.

D. sericatum Dall. (Pl. 7, fig. 12). " Shell small, very thin, acute, slightly curved, rather rapidly enlarging, covered with fine, sharp, close-set longitudinal grooves, with narrow thread-like interspaces separating them, to the number of thirty-six on the middle and about fifty at the oral end of the shell ; plane of oral aperture at right angles to the axis, both apertures circular, simple; color

translucent white, with opaque white wavy lines (like those on the silk goods known as *moire antique*) encircling the shell with zig-zags, whose successive irregular bands (0·8 mill. apart in the middle of the shell) are sub-parallel with one another, and gradually become more slender and further apart toward the ends. In a specimen 13 mill. long, there were about fifteen of these bands, each with about ten or twelve angles. Length 13 mill., oral diam. 1·2 mill., anal 0·37 mill. (*Dall*).

"This species is more acute than *D. taphrium* of the same size, and the *moire antique* effect is of a much more prominent and zig-zag pattern. In *D. taphrium* the sculpture is also coarser. A somewhat similar effect is observable on the younger portion of *D. aculeatum* Sowerby, which is otherwise very different. The Indo-Pacific *D. nebulosum* Deshayes also exhibits it. The sculpture is entirely independent of these differences of opacity, which at first one finds it difficult to realize." (*Dall*).

D. CIRCUMCINCTUM Watson. Pl. 8, fig. 26.

Shell very long and narrow, very slightly bent, and that almost entirely above; a very little flattened on the concave curve, so as to be slightly trigonal; white, opaquely porcellanous, a little glossy, not thick but strong. Sculpture: closely and regularly girt round, elliptically with scratch-like puckerings in the lines of growth, of which there are about 55 in the tenth of an inch. Longitudinally striped with fine ribs, of which there are from 17 to 20, sharp and well defined by still broader furrows toward the apex, but down the shell these increase in number and steadily decrease in definiteness till they only show as a feeble system of lines on the rounded surface. At the apex there is on the convex curve a ragged irregular fissure about 0·1 inch long. Length 1·93 [48 mill.], breadth at mouth 0·13 [3·25 mill.], at apex 0·02 inch. (*Watson*).

Setubal 470 fms.; *Sombrero I., W. Indies* 450 fms.; *off Bermuda* 1075 fms.; *Pernambuco* 350 fms. (Challenger).

D. circumcinctum Wats., Journ. Lin. Soc. Lond., xiv, p. 513 (1879); Chall. Rep., p. 7, pl. 1, f. 7.

As compared with *D. semipolitum* Sow., this is a longer, straighter, more attenuated shell, with striæ stronger, blunter, and more persistent. It is not unlike *D. antillarum* d'Orb., in texture and in size, but is much straighter and narrower, and the early ribs are much finer and fewer. It is intermediate in form between *D.*

erectum G. B. Sow. and *D. splendidum* Desh.; a little stumpier and more curved than the first, and less so than the second; it is much more longitudinally ribbed and less polished than either. Than *D. lessoni* Desh., it is much more attenuated, and never so strongly ribbed longitudinally; than *D. inversum* Desh., it is more strongly and persistently striate longitudinally. The young shell is perplexingly like that of *D. entalis* var. *orthrum* Wats., but is a little straighter, broadens more slowly, and the ribs project more sharply. In maturer specimens this species is obviously much more attenuated than the former. (*Wats.*).

D. EBOREUM Conrad. Pl. 16, figs. 47, 48, 49, 55, 56.

Shell slender, attenuated posteriorly, gently curved, shining, white. Sculpture: extremely close, fine, but rather deeply engraved longitudinal striæ toward the apex, the larger part of the shell smooth and glossy. Aperture slightly oblique, circular; peristome thin. Anal orifice small and round. No notch or slit. Length 20, diam. of aperture 1·8, of apex 0·35 mill.

West coast of Florida: Tampa (Conrad); *Marco* (Hemphill); *Sanibel Island* (Johnson).

D. eboreum CONRAD, Proc. Acad. Nat. Sci. Philadelphia, iii, p. 27 (1846).

The description and figures are from Conrad's type specimen in the collection of the Academy. It is allied to *D. semistriatum* Turt., but is less curved and more slender.

Specimens collected at Sanibel Island by Mr. C. W. Johnson, two of which are illustrated on pl. 16, figs. 55, 56, indicate that the species attains a much larger size than the types. As the figures show, they vary much in arcuation; and they have lost the posterior striation by truncation in the course of growth. The shells figured measure:

Length 31, diam. at aperture 2·5, at apex 0·8 mill.

Length 27·4, diam. at aperture 2·2, at apex 0·75 mill.

D. LEPTUM Bush. Pl. 16, fig. 50.

Shell of moderate size, very slender, slightly curved posteriorly, rather thin, delicate, with a very *smooth and glossy surface, destitute of sculpture, except at the posterior end, which is covered with numerous, very fine, raised, longitudinal lines* visible only under the lens. Anterior aperture round, with a sharp, thin edge; posterior aperture somewhat thickened, very small, round, slightly oblique, with

a deep narrow dorsal notch. Color delicate salmon or yellow, gradually shading into white toward the anterior end. Length 31·5 mill., anterior diam. 2, posterior diam. about 0·5 mill. (*Bush*).

Vicinity of Cape Hatteras, N. C., to Charlotte Harbor, Florida in 2–50 fms.; *older Miocene of Chipola River, Florida.*

D. leptum Bush, Trans. Conn. Acad., vi, p. 470, pl. 45, f. 18, 18a (1885); Rep. U. S. Fish Commission for 1883, p. 586 (1885). —Dall, Blake Rep., Bull. M. C. Z., xviii, p. 421; Bull. U. S. Nat. Mus., No. 37, p. 76; Trans. Wagner Inst., iii, p. 440 (1892).

This beautiful and distinct species is readily recognized by its orange tint and slender form, delicately and closely striated near the tip. (*Dall*).

Some of the Fish Commission specimens marked *leptum* from off Hatteras proved to be *D. matara.*

D. semistriatum Turton. Pl. 16, figs. 51, 52, 53.

Shell slender, tapering and attenuated posteriorly, translucent-white, milky, sometimes slightly tinted toward the apex, polished. Sculpture of *fine, regular, clearly cut and close longitudinal grooves separating narrow lirulæ, which extend over the posterior third* (more or less) *of the shell's length*; *the remainder very glossy, without sculpture* other than slight irregularities of growth. Aperture somewhat oblique, circular. Anal orifice minute, circular, and normally unslit.

Length 26, diam. of aperture 2·2–2·6, of apex 0·6 mill.

Carribean Is.: St. Martins (E. Marie), *and Saba* (Swift).

D. semistriatum Turton, Conchol. Dict. Brit. Is., p. 39, pl. 18, f. 68 (1819); compare Forbes and Hanley, Hist. Brit. Moll., ii, p. 454. —*D. translucidum* Chenu, Ill. Conch., i, p. 8, pl. 3, f. 12, not of Deshayes.—*D. semistriolatum* Guilding, Trans. Linn. Soc. Lond., xvii, pt. 1, p. 34, pl. 3, f. 1–5 (1834).

Both Turton and Guilding have given good descriptions and figures of this species, although later writers have singularly overlooked them. We believe the West American form, *D. semipolitum* B. & S., with its synonyms, to be identical, numerous specimens before us showing no constant differential characters. The species differs from *D. sericatum* Dall in lacking the conspicuous (though variable) zig-zag color-pattern, and the tube does not increase so rapidly. *D. leptum* Bush is more slender, the length fully 15 times the diameter of aperture; *D. eboreum* is also more attenuated and straighter.

The following specific names are synonymous, in our opinion: *D. semistriatum* Turton (1819), *D. semipolitum* Brod. & Sowb. (1829), *D. semistriolatum* Guild. (1834), *D. hyalinum* Phil. (1846), *D. liratum* Carp. (1857), and *D. lirulatum* Mörch (1861). The known geographic range includes the Gulf of Mexico and west coast of Mexico and Lower California. While we have no doubt of the correctness of the above synonymy, we give below, under separate heading, a description of the west American race.

Var. SEMIPOLITUM Broderip & Sowerby. Pl. 16, fig. 54.

Shell slender, moderately or decidedly curved, attenuated toward the apex; rather thin, milk white and very glossy. Sculpture: *deeply engraved with very numerous, fine, close, subequal, longitudinal striæ, extending from the apex downward one-third to two-thirds the shell's length* (and of course covering the entire length of young shells); the *remaining one- or two-thirds smooth and polished,* brilliant, scarcely showing growth-lines. Aperture circular, the peristome thin. Anal orifice minute and round, *no notch or slit.*

Length 26, diam. of aperture 2·6 mill.

Length 29·5, diam of aperture 2·9 mill.

La Paz; Acapulco; Mazatlan; north to Mulege Bay, Boca de los Piedras and San Ignacio Lagoon, Lower California, and San Diego, California.

D. semipolitum B. & S., Zool. Journ., iv, p. 369 (1829).—? *D. semipolitum* SOWB. Jr., Thes. Conch., iii, p. 100, pl. 224, f. 23; Conch. Icon., xviii, pl. 4, f. 19.—*D. semipolitum* Sowb. CARPENTER, Suppl. Rep. Moll. West Coast N. A., Brit. Asso. Adv. Sci. for 1863, pp. 612, 648, 666 (1864); and in Smiths. Misc. Coll., No. 252, pp. 98, 134, 152.—*D. semipolitum* Cp., STEARNS, Proc. U. S. Nat. Mus., xvii, p. 158 (1894).—*D. hyalinum* PHIL., Zeitschr. f. Malak., iii, p. 55 (1846). Not *D. hyalinum* Ph., CARPENTER, Mazatl. Catal., p. 188. —*D. liratum* CARPENTER, Ibid., p. 188 (young shell).—SOWERBY. Thes. Conch., iii, p. 101, pl. 224, f. 32; Conch. Icon., xviii, pl. 5, f, 34.—*D. lirulatum* MOERCH, Malak. Blätter, vii, p. 177 (1861).

Compared with *D. aciculum* of the same length, a larger part of the surface of *D. semipolitum* is seen to be striated. It is a very beautiful shell, quite constant in the fine sculpture of the smaller end, though, as in all species, with diverse ornamentation at the two ends, the extent of the sculptured and smooth portions varies regularly with age, and somewhat among adults. Quite young and half-

grown shells are striate throughout; and in some of the old ones less than a third of the shell is sculptured. In form there is also considerable variation, occasional examples fully justifying Philippi's term "*subrecta*," while others are very markedly arcuate.

We have noted above the essential identity of this form with the Antillean *D. semistriatum* Turton. In the average, a greater portion of the tube is striated in this than in *D. semistriatum;* but in many individual specimens this does not hold, and they are quite indistinguishable. The West Coast form is, at most, only a subspecies.

The original description of this species is as follows:

"Shell whitish, polished; posterior end somewhat recurved, very finely striated; no posterior slit. Length 1·4, diam. 0·1 inch. The very fine striæ continue about half the length of the shell, which is rather narrower in proportion than *D. nebulosum*" (*B. & S.*).

The habitat of the type was unknown, but as a large number of the shells described in Broderip and Sowerby's paper, cited above, were from the west coast of Mexico, it is very probable that the original *semipolitum* came from thence, especially as their description agrees perfectly with specimens from that region.

It has also been well-described by Philippi as *D. hyalinum*, and young shells, in which the striæ extend from end to end, have received the names *lirulatum* Mörch and *liratum* Carpenter. All published information upon the latter two forms is given below.

D. lirulatum Mörch. Shell arcuate, dilated toward the aperture, apex attenuated; thin, white, very closely lirulate with beautiful regularity, the interstices deep, milk-white; growth-striæ wanting. Length 8, diam. 1·25 mill. (*Moerch*).

Gulf of Nicoya, west coast of Costa Rica (Oersted).

Has the form of *D. acuminatum* Deshayes. It is probably a young shell of the *D. semipolitum* group, and nothing in the diagnosis precludes the supposition that it is identical with that species.

D. liratum Carpenter. Shell solid, white, cylindrical, little curved, very closely covered with very delicate longitudinal liræ numbering in the young about 12, in the adult about 30; they are acute and hardly of equal size. Branchial [anal] orifice simple. One perfect though rather small specimen was found entangled in the byssus of *Modiola capax;* fragments occurred of a much larger size. Length ·25, breadth ·011–·03 inch [L. 6·25, greatest diam. 0·75, apical diam. 0·275 mill.].

Mazatlan, off *Modiola capax*, *Chamæ* and *Spondyli*, very rare. Liverpool Coll. Tablet 879 contains the perfect specimen, a small one wedged in the mouth of *Trivia sanguinea*, and a fragment of a large one, ·065 [= 1·625 mill.] across (*Carpenter*).

Carpenter, who described a good deal of trash as well as many good species in the Mazatlan Catalogue, makes a wrong identification of *D. hyalinum* Phil., and redescribes its young as above.

D. ACICULUM Gould. Pl. 17, figs. 65, 66, 67.

Shell slender, considerably tapering, attenuated posteriorly, moderately curved throughout but more toward the apex; glossy white, nearly opaque. Sculpture of *fine, close, deeply engraved longitudinal striæ near the apex* (extending over only a seventh the total length in the type specimen), *the remainder of the shell smooth and polished*, with faint growth-striæ only. Aperture circular, a trifle oblique. Anal orifice with a slight notch on the convex side (fig. 67) and a concave wave on the opposite part. Length 24, diam. at aperture 2·55, at apex 0·6 mill.

Coast of China, 23° 50′ N. lat., in 25 fms. sand (Stimpson).

D. aciculum GLD., Proc. Bost. Soc. N. H., vii, p. 165 (1859); Otia Conch., p. 119.—SOWB., Conch. Icon., xviii, pl. 7, f. 52 (1872).

? *D. semipolitum* COOKE, Ann. Mag. N. H. (5), xvi, 1885, p. 273. —SMITH, Ann. Mag. N. H. (4), xvi, 1875, p. 113.

Compared with *D. semipolitum* from the Gulf of California the type of *D. aciculum* is striated for a much shorter distance, increases slightly less in calibre, and is distinctly notched at apex. Whether these differences are specific or merely individual we have not enough Oriental material to decide. Probably Cooke's *semipolitum* from the Gulf of Suez (MacAndrew!) and Smith's from Cape Shima and Matoza Harbor, Japan, 6–18 fms. (St. John!) are Gould's form, rather than the true *semipolitum*.

The description and figures are from the type, No. 14149, U. S. Nat. Mus.

D. NOVÆHOLLANDIÆ Chenu. Pl. 17, fig. 64.

Shell subarcuate, whitish, smooth anteriorly, with very minute striæ on the posterior third. A species of large size, white, glossy, remarkable for the fine striation of the upper (smaller) end, while the larger portion is smooth with faint growth-striæ only (*Chenu*). Length 76, diam. of aperture 4·2 mill. (from fig.).

Australia (Chenu).

D. novæ hollandiæ Chenu, Ill. Conch., i, p. 5, pl. 6, f. 14.

Like so many of Chenu's species, this is known by the original publication only. It is unusually large for the present group.

D. acutissimum Watson. Pl. 20, fig. 26.

Shell long and much attenuated, rather straight and very regularly curved, very thin, brilliant and glassy. Sculpture: The surface is crossed by fine, sharpish, irregular striæ, which run very elliptically round. In the young shell the surface is regularly and finely scratched by a great number of close-set, regular, sharp and extremely minute lines, which very gradually become more and more faint, but are still traceable even in the full-grown shell. The color is pure white, transparent, and almost hyaline in the fresh shell, but in the dead shell the interior (not, as usual, the exterior) layers of the shell become opaque and chalky. The edge is very thin and irregularly broken. At the apex the end is abruptly broken off in one specimen, and in the other there is an irregular fissure with an internal lining process. In one specimen from Station 246, which is full-grown, but very short, a large, thin, irregularly shaped process projects, which, being obliquely cut off somewhat across the shell, supplies the anal orifice. Length 1·52 in., of young specimens from Station 218; breadth at mouth 0·12, at apex 0·026 inch. Length 1·14, of old and broken specimen, Station 246; breadth at mouth 0·23, at apex 0·14 inch (*Watson*).

N. of Papua, 1070 fms.; *mid-Pacific*, *E. of Japan*, 2050 fms. (Challenger).

D. acutissimum Wats., Journ. Linn. Soc. Lond., xiv, p. 514; Chall. Rep., p. 8, pl. 1, f. 8.

Compared with *Dentalium leptoskeles* Wats. this is more curved, more conical, and thus not nearly so attenuated. Compared with *Dentalium agile* Sars also, this is more curved, rather more conical, and very much more delicate. It is likewise, when full-grown, apparently larger than either. Than *Dentalium lubricatum* G. B. Sow. this broadens more rapidly, is more brilliant, the circular striæ are stronger, the longitudinal are finer, closer and sharper. It is also straighter than that species. Than *Dentalium pretiosum* Nuttall this broadens faster and is much more brilliant. *Dentalium perlongum* Dall lacks the faint longitudinal striæ, is much straighter and is more slender; thus if one chooses a point where the breadth in the two species is equal, then within about an inch *Dentalium*

perlongum Dall is not so much as two-thirds of the breadth of *Dentalium acutissimum*. Contrary to Mr. Dall's statement, however, the two species agree in having the anal fissure on the convex side.

In reference to the form of the apex, it may be observed that the separation of the *Dentalia* by the absence (Dentalium) or presence (Entalis) of the cleft-process cannot be maintained. In *Dentalium abyssorum* Sars there are some with a fissured process, some with a fissure without any process, some with neither fissure nor process. There are cases in which the fissure is very regularly formed, in others it looks as if it had been gnawed, in others it resembles a break; sometimes it is on the convex curve, as in the general case, sometimes on the concave as in *Dentalium inversum* Desh. and in *Dentalium subterfissum* Jeffr.; sometimes it is irregularly lateral as occasionally in *Dentalium agile* Sars (*Wats.*).

D. INVERSUM Deshayes. Pl. 21, figs. 47, 48, 49.

Shell rather lightly curved, small, *extremely slender*, the length about 16 times the greatest diameter; translucent white, clouded with opaque white, and becoming reddish toward the apex; *very glossy*. Sculpture, *very fine and regular longitudinal striation near the apex*, the greatest part of the shell smooth, free from sculpture, with *very slight* variceal rings as in *D. eburneum* but far less marked. Aperture circular, the peristome thin. Anal orifice minute, round, with a *deep, narrow slit or a shorter notch, in the middle or excentric on the concave side*. Length 30, diam. of aperture 1·9, of apex 0·6 mill.; length of slit 1·8 mill.

Gulf of California (W. Newcomb, in coll. Acad.); *Habitat unknown* (Desh., Sowb.).

D. inversum DESH., Mém. Soc. Hist. Nat. Paris ii, p. 370, pl. 16, f. 21, 22 (1825).—SOWERBY, Thes. Conch., iii, p. 99, pl. 225, f. 42; and in Conch. Icon., xviii, pl. 7, f. 51.—E. A. SMITH, P. Z. S., 1871, p. 738.

Remarkable for having the slit on the concave side. Otherwise the species is not very unlike *D. semipolitum*. *D. sectum* Desh. differs in being less attenuated posteriorly, with differently formed apex and slit.

One specimen from the Gulf of California, which we refer to this species, has the apical notch formed as in many *D. entalis*, with a slightly projecting rim around the ovate orifice, slit not median, but decidedly excentric on the concave side. This specimen occurred with *D. semipolitum* B. & S.

Smith reports *D. inversum* from Whydah, West Africa (Capt. Knocker!).

D. SPLENDIDUM Sowerby. Pl. 15, fig. 38.

Shell thin, polished, flesh-colored at base, milk-white toward the apex; posterior orifice with two slits, one dorsal, the other ventral. Length 1·8, diam. 0·15 inch.=45, 3·75 mill. (*G. B. S.*).

Xipixapi, west coast of Colombia, 10–16 fms. (Cuming).

D. splendidum G. B. SOWERBY, P. Z. S., 1832, p. 29.—SOWB. Jr. Thes. Conch., iii, p. 98, pl. 225, f. 41; Conch. Icon., xviii, pl. 5, f. 30.—? *D. fissura* Lam., SOWB., Thes. Conch., iii, p. 98, pl. 225, f. 43, not *D. fissura* of Lamarck, Philippi or Costa.

The apical slit is somewhat as in *D. sectum* Desh., but not reduced to a narrow cut above by an apical plug. "Generally reddish near the apex, and white toward the base. In some specimens there are two fissures, one dorsal, the other ventral."

GROUP OF D. SECTUM.

Shell subcylindrical, the apex obliquely truncate, with an oblique, convex plug, perforated by a narrow antero-posterior slit.

I. Shell longitudinally striated from apex to or nearly to aperture, *calamus.*

II. Apical half striated, the rest smooth, *sectum.*

D. SECTUM Deshayes. Pl. 17, figs. 60, 61, 62, 63.

Shell small, slender, *very little tapering*, slightly curved, white and glossy. Sculpture of *very numerous, close, subequal fine riblets extending longitudinally from apex about half way to aperture; the remaining half with fine growth-striæ* but no longitudinal sculpture. Aperture circular, not oblique, with acute peristome. Apex with a high, *obliquely conical, smooth plug, perforated by an antero-posterior slit.* Length 24, diam. of aperture 1·7, diam. of apex below plug 1·2 mill.

Gulf of California (W. Newcomb, in coll. Acad.); *Habitat unknown* (Desh., Sowb.).

D. sectum DESH., Mém. Soc. Hist. Nat. Paris, ii, p. 367, pl. 18, f. 12–14 (1825).—SOWERBY, Thes. Conch., iii, p. 99, pl. 224, f. 35 (1860); and in Conch. Icon., xviii, pl. 5, f. 28 (1872).—*Antalis secta* CLESSIN, Conch. Cab., p. 26.—*D. diffusum* CHENU, Ill. Conch., i, p. 3, pl. 6, f. 11, 12.

Very peculiar in the anal plug and slit which are formed as in *D. calamus*, a species differing only in being striated throughout. The sculpture is characteristic of a small group of species comprising the above named forms and the *D. semistriatum* group, which though varying greatly in the details of the anal slit, we hold to be closely allied.

D. CALAMUS Dall. Pl. 17, figs. 55, 56, 57, 58, 59.

Shell very slender, slightly arched, white, translucent, the soft parts showing through the shell; finely longitudinally grooved [throughout, or for the greater part of the length], the grooves uniform, the interspaces flat and slightly wider anteriorly; aperture hardly oblique, anal end apparently *trimmed off obliquely for a short distance on the convex side, glandiform, phallic, vertically narrowly slit*, the slit longer on the convex side, the "glans"-like portion smooth, polished, usually with a little ledge around it. Length of shell, 19·5; height of arch from chord, 2·25; diameter of aperture, 1·25; of anal end behind the "glans," 0·8 mill. Grooves in the middle part of the shell about sixteen to the millimeter of circumference. (*Dall*).

Turtle Harbor, Florida, in 4 fms.; *and Cape Fear* (Dr. W. H. Rush, U. S. N.); *Pliocene of the Caloosahatchie, Florida.*

D. calamus DALL, Blake Rep., Bull. M. C. Z., xviii, p. 421 (1889); Bull. U. S. Nat. Mus., no. 37, p. 76; Trans. Wagner Institute, iii, p. 440.

D. calamus differs from the very closely allied *D. sectum* in being striate for nearly or quite its entire length, while the other is smooth toward the aperture. Very young specimens of *calamus* have the slit much more open, and the form tapering. *D. calamus* attains a length of 26, diam. of aperture 1·7, of apex 1·3 mill. Figs. 58, 59 are drawn from a Florida specimen in which the anterior portion of the tube is smooth for a short distance; figs. 55–57 are from a specimen taken off Cape Fear, striate throughout. The name is doubly appropriate.

Subgenus LÆVIDENTALIUM Cossmann, 1888 (*s. lat.*).

Lævidentalium COSSM., Ann. de la Soc. Roy. Malacologique de Belgique, xxiii, p. 9. Type *D. incertum* Desh.

Shell of moderate or large size, smooth, with growth lines only circular or slightly oval in section; apex simple (typically), or with a short notch on the convex side as in *Antalis*. Type *D. incertum.*

M. Cossmann founded this group to include smooth species with the shell oval in section, the posterior orifice without a slit. In dealing with recent species we find it practically impossible to draw the line between circular and slightly oval forms; and the apical characters seem insufficient ground, in our opinion, for the separation of species with no slit from those with an *Antalis*-like extremity. In accepting the distinguished French palæontologist's group, we therefore enlarge its bounds beyond those originally intended; and are alone responsible if future investigators find that heterogeneous materials are included therein.

I. Apex simple, without notch or slit, *Group of D. lacteum*, p. 98.
II. Apex with a slit or notch, *Group of D. matara*, p. 102.

Group of D. lacteum.

Smooth, polished, moderately curved shells with the apical orifice simple, not notched or slit.

Of recent species, these are nearest to the type of *Lævidentalium;* but the distinction between a notched and simple anal orifice is in actual practice rather delusive. One encounters many apparently perfect individuals of species typically notched, in which the apical margin is entire; and yet no fracture other than the normal truncation of the apex with increasing age, may appear. It is only when numerous specimens of various age are available for study, that the systematic position of some species can be ascertained. Occasional old specimens of the group of *D. semistriatum* have the characters of the present group; and more frequently specimens of the *D. matara* group may be looked for here. The key given below must therefore be used with caution. It is moreover rather unsatisfactory on account of the absence of readily describable characters in these smooth simple shells.

Key to Species.

(Consult also the group following this, p. 102, and that preceding, p. 85).

1. Large and stout, length 75 mill., 7½ times the diameter; rather straight, polished, opaque and solid, rapidly increasing. Cape Horn, *lebruni*, p. 102.

II. Small, white, nearly straight; length 15 mill., nearly 9 times the diameter. New Zealand, *ecostatum*, p. 102.

III. Much narrower, the diameter contained over 10 times in the length.

a. Circular striæ or rings toward smaller end.
  b. Transparent, with incised circular lines on smaller, smooth on larger half of shell; length 14 mill. N. E. Australia, *anulosum*, p. 101.
  b'. White, thin, narrow, circularly striate at apex; length 22 mill., 11 times the diameter. Suez, *subtorquatum*, p. 101.
a'. Smooth, nowhere conspicuously striate.
  b. Quite arcuate. Antillean.
    c. White, arcuate, very slender; length 24 mill., 15 times the diameter, *ensiforme*, p. 101.
    c'. White or pale salmon, rapidly tapering; length 61½ mill., about 12 times the diameter, *callipeplum*, p. 100.
  b'. But slightly curved; thin. Habitat unknown.
    c. Greenish-yellow; length 25 mill., 10 times the diameter, *translucidum*, p. 99.
    c'. Color?; very acute; longer and less curved than *translucidum;* length 37 mill., about 12 times the diameter, *ambiguum*, p. 100.
    c''. Milky subtranslucent; length 30 mill., 12 times the diameter, *lacteum*, p. 99.

D. LACTEUM Deshayes. Pl. 19, fig. 1.

Shell cylindrical, somewhat curved, very smooth and polished, whitish, milky, subtranslucent.

Smaller than *entalis*, and proportionally less in diameter, invariably of a milky, subtransparent color, thinner than *entalis* and not striated at the small end. Length 30, diam. 2½ mill. at the base. No slit. (*Desh.*).

India (Desh.).

D. lacteum DESH., Mém. Soc. Hist. Nat. Paris, ii, p. 362, pl. 16, f. 27 (not 28, as given by Desh.).—SOWB., Thes. Conch., iii, p. 98, pl. 225, f. 48. Not *D. lacteum* Costa, Faun. Reg. Nap., p. 37. Probably not *D. lacteum* Dh., Tate, Tr., Proc. and Rep. Roy. Soc. S. Austr., ix, p. 193.

We have not seen specimens certainly referable to this species.

D. TRANSLUCIDUM Deshayes. Pl. 19, fig. 5.

Shell cylindrical, rather straight, polished, transparent, greenish-yellow; calcareous and solid, smooth. Length 25, diam. 2·5 mill. (*Desh.*).

Habitat unknown.

D. translucidum Desh., Mém. Soc. Hist. Nat. Paris, ii, p. 362, pl. 16, f. 26 (1825). Not of Sowb., Thes. Conch., iii, p. 98, pl. 225 f. 47 (1860).—Not *Antalis translucidum* Cless., Conch. Cab., p. 24.

The form identified as *translucidum* by Sowerby has a linear, very long slit, and belongs to the subgenus *Fustiaria* Stol. Deshayes states that there is no slit in his *D. translucidum* (see Monogr. Dent., p. 345); so it is evident that Sowerby's shell is a different thing.

D. ambiguum Chenu. Pl. 19, fig. 4.

Shell somewhat straight, smooth; whitish-gray maculated with black or violaceous, the apex very acute. (*Chenu*).

Locality unknown.

D. ambiguum Chenu, Illustr. Conch., i, p. 1, pl. 3, f. 1.

According to Deshayes' manuscript note, the sole example of this species had long lain dead in the mud, and become blackened in color in place of the pale corneous or yellow which was probably the normal tint. It is allied to *D. translucidum*, but longer and less arcuate. The surface is smooth and glossy. Length 37, diameter of aperture 3 mill.

D. callipeplum Dall. Pl. 19, fig. 9.

Shell ivory-white to pale salmon color, glistening, elegantly arched, rapidly increasing; sculpture of faint girdling incremental lines, and toward the tip faint longitudinal scratches, hardly discernible; section circular, the lower edge projecting a little in the adult aperture; tip entire, circular in the youngest, but in the adult with a wide very shallow notch on the concave side. Anterior diameter, 5·0; posterior diameter, 0·5; length of shell, 61·5; height of arch above the chord, 10·0 mill. (*Dall*).

Near Santa Cruz, in 180 fms. ooze; *off Saba Bank*, a fragment, in 150 fms.; *off Guadelupe*, in 175 fms., sand; *off Santa Lucia*, in 116 fms., hard bottom; *off Grenada*, in 92 fms., sand (Blake). *Also off South Carolina*, in 159 fms., sand, and in the *Gulf of Mexico*, in 169 fms., mud (U. S. Fish Commission). *Also Pliocene of Caloosahatchie River, Florida.*

D. callipeplum Dall, Blake Rep., Bull. M. C. Z., xviii, p. 419, pl. 27, f. 12b. (1889); Bull. U. S. Nat. Mus., no. 37, p. 76, pl. 27, f. 12b (1889); Trans. Wagner Free Institute of Science, iii, p. 442.

This elegant species has also been received from the coast of Honduras and from Samana Bay, St. Domingo. Its nearest relative is

D. rubescens Deshayes, which is less curved in front and more curved near the tip, is smaller, deeper colored, and has a very long narrow posterior slit when perfect, quite different from that of *callipeplum*.

The specimen figured is young; better specimens, from which the description was drawn up, were dredged by the Fish Commission. The striation on the tip is so faint as to be very difficult to see, while the surface is so brilliant as not easily to be scrutinized. (*Dall*). It has the oily luster of *D. longitrorsum*.

D. ENSIFORME Chenu. Pl. 15, fig. 37.

Shell arcuate, smooth, white, the aperture oblique. (*Chenu*).

Antilles.

D. ensiforme CHENU, Illustr. Conchyl., i, p. 3, pl. 6, f. 18.

Deshayes remarks: Very near *inversum* in curvature and size, but that differs in the slit; narrower than *lacteum*. Length 24, diam. at aperture slightly exceeding 1·5 mill.

D. SUBTORQUATUM Fischer.

Shell white, thin, narrow, shining, cylindrical, slightly curved. Encircled at the apex with minute, close, somewhat raised transverse striæ. Apex entire. No longitudinal striation. Length 22, diam. 2 mill. (*Fischer*).

Suez (Gaudry).

D. subtorquatum FISCHER, Journ. de Conch., xix [(3) xi], pp. 218, 212 (1871).

D. ANULOSUM Brazier.

Shell thin, transparent, tapering, slightly curved, marked by incised circular lines from the apex to the centre, and from that to the base quite smooth, apex thickened, perforated, perforation entire, aperture circular. Length 7 lines [14 mill.] (*Braz.*).

Princess Charlotte Bay, northeast Australia, 13 fathoms, sandy bottom (Chevert Exped.).

Dentalium anulosum BRAZIER, Proc. Linn. Soc. N. S. Wales, ii, p. 58 (1877).

The upper part of this beautiful, thin, transparent shell has a ringed appearance like a trachea. Allied to *Dentalium politum* Linn., that species being distinguished by the incised lines that divide its whole length (*Braz.*).

D. ECOSTATUM Kirk. Pl. 18, fig. 13.

Shell white, nearly straight, smooth, gradually tapering, faintly, distantly, transversely striated. Length 0·6, breadth at anterior end 0·07 inch = 15, 1·75 mill. (*Kirk*).

Waikanae, New Zealand (Kirk); *also Pliocene of N. Z. at Wanganui and Petane* (Hutton).

D. ecostatum KIRK, Ann. Mag. Nat. Hist. (5), vi, p. 15 (July, 1880); Trans. N. Z. Institute, xii, p. 306 (May, 1880).—HUTTON, Macleay Memorial Volume, p. 80, pl. 8, f. 79.

Shell small, slightly curved, quite smooth, polished (*Hutton*). The illustration is from Hutton's figure of a Pliocene specimen.

D. LEBRUNI Mabille & Rochebrune.

Shell rather straight, slightly curved toward the apex, white, polished, opaque and solid; at the base rapidly increasing; apex entire, neither slit nor emarginate. Length 75, greatest diam. 10 mill. (*M. & R.*).

Santa Cruz, Patagonia (Lebrun).

D. lebruni MAB. & ROCH., Miss. Sci. Cap Horn, vi, Zool., Moll., p. 99 (1889).

A nearly straight shell, only toward the apex a little arcuate; white, polished, without striæ except at the base, where they are quite perceptible. This species somewhat resembles *D. lubricatum* Sow. of the coast of Australia, but it is larger, narrower, decidedly less curved, and thinner at the summit (*M. & R.*).

Group of D. matara.

Smooth and polished, elongated species, circular or subcircular in section, with the apical characters of typical *Antalis* or of *Fissidentalium*—a V-shaped notch or a slit.

Those who attach cardinal value to the modifications of the apex would place most or all of these forms in *Antalis* (*Entalis* or *Entaliopsis*). They have a more or less projecting rim or sheath around the anal orifice, interrupted by a slit or V-shaped notch on the convex side. In including the group under *Lævidentalium*, we emphasize rather the smooth surface; but neither course is entirely satisfactory to us.

Key to Species.

I. Shell much curved throughout, amber, carnelian or white, aperture circular; length about 90 mill., about 19 times the diam., *longitrorsum*, p. 111.

II. Shell with slight or moderate curvature.
  a. Aperture circular or nearly so.
    b. Apex slit on the concave side; bluish-white, polished; length 24–27 mill., 12–13 times the diameter. West Indies, *alloschismum*, p. 108.
    b'. Apex notched on both convex and concave sides.
      c. Moderately curved; yellow corneous; length 33 mill., 11 times the diam., *bisinuatum*, p. 108.
      c'. Nearly straight; reddish toward apex; length 55 mill., about 14 times the diam.; Australia, *erectum*, p. 111.
    b'' No notch on concave side.
      c. Shell white, with annular swellings; Mediterranean, *siculum*, p. 107.
      c'. No annular swellings.
        d. Very slender; length 50–80 mill., about 25 times the diam., *perlongum*, p. 104.
        d'. Less slender; salmon or carnelian tinted toward apex.
          e. Length 41 mill., about 15 times the diam.; Antillean, *matara*, p. 105.
          e'. Length 33 mill., about 9–10 times the diam.; Mediterranean, etc., *rubescens*, *malzani*, pp. 105, 107.
        d''. Less slender; white or whitish.
          e. Faintly striated longitudinally; length 15 mill., about 6½ times the diam.; quite tapering, *diarrhox*, p. 109.
          e'. No longitudinal striation; aperture slightly compressed vertically; length 37 mill., about 12½ times the diam., *leptosceles*, p. 110.
          e''. Length 64 mill., 10–11 times the diam.; Australia, *lubricatum*, p. 110.
          e'''. Smooth, subtranslucent, bluish-white; a slit on convex side; length 25 mill., 12–13 times the diameter, Antilles, *liodon*, p. 107.
  a'. Aperture and section of the tube oval.
    b. Large; length 105 mill., 11–12 times the diam., *caudani*, p. 104.

b'. Smaller; tube flattened on concave side; length 36 mill., about 14 times the diam., *insolitum*, p. 109.

b''. Smaller; tube slightly compressed vertically; much tapering; length 37 mill., about 12½ times the diam., *leptosceles*, p. 110.

D. PERLONGUM Dall. Pl. 18, figs. 10, 11.

Shell solid, opaque white, shining, without sculpture, except delicate irregularities due to incremental lines; oral aperture simple, nearly circular, its plane quite or nearly at right angles to the axis. Anal aperture with a shallow notch (in adult specimens) on the convex side; tube very slightly curved. Length 50 to 80 mill., oral diam. 3·5 mill.; anal diam. 0·5 to 0·7 mill. (*Dall*).

Yucatan Strait, 640 fms.; *off Guadelupe* in 734–769 fms.; *off St. Vincent* in 424–785 fms.; *off Bequia* in 1507–1591 fms.; *off Grenada* in 792 fms. (Blake). *Off Cape Hatteras, N. C.*, in 683 fms.; *Gulf of Mexico, between Mississippi delta and Cedar Keys, Fla.*, in 227–1191 fms.; *Florida Keys;* also *90 miles north of Ceara, Brazil*, 1019 fms. (Albatross).

Dentalium perlongum DALL, Bull. M. C. Z., ix, p. 36 (July, 1881); Ibid., v, p. 61, 1878 (no description); Ibid., xviii, Blake Moll., p., 419, pl. 27, f. 6; Bull. 37, U. S. Nat. Mus., Catal. Mar. Moll. S.-E. U. S., p. 76, pl. 27, fig. 6; Proc. U. S. Nat. Mus., xii, p. 294.—DALL in Agassiz, Three Cruises of the Blake, ii, p. 67, f. 284 (1888).

This fine species has been carefully compared with all those from deep water in the Jeffreys collection, and seems fully distinct from any of them. Mr. Watson observes that the young resembles *D. longitrorsum* Reeve in texture and general appearance, but is straight. *D. acutissimum* Watson is stouter and more curved (*Dall*).

The fissure is Antalis-like; our figure 11 was drawn from one of the types.

D. CAUDANI Locard. Pl. 18, fig. 12.

Shell relatively very large, of a very narrowly conoidal form, much elongated and progressively attenuated, feebly arcuate a little past the moiety of the length; shell quite thin, smooth and glossy throughout, showing only fine, crowded, irregularly and slightly oblique concentric growth lines; aperture very obviously oval, slightly oblique; apical fissure narrow and short; color grayish-white. Length 105, diameter of aperture 9, at apex 1 mill.; curvature 9 mill. (*Locard*).

Gulf of Gascony, 1300 meters (Caudan Exped.).

D. caudani Loc., Ann. Soc. Agric. Lyon (7), iv, p. 213 (1896); Rés. Sci. Camp. du Caudan, i. p. 171, pl. 6, f. 2.

Particularly characterized by the great size and the smooth, glossy shell. It is much less slender than *D. perlongum* Dall, straighter below, and oval in section.

D. MATARA Dall. Pl. 18, figs. 14, 15, 16, 17, 18.

Shell slender, salmon-colored, whiter toward the aperture, glistening, the lines of growth hardly perceptible in fresh specimens, other sculpture none; very slightly arched; aperture circular, very little oblique; anal orifice higher than wide, slightly notched below and above, with a short, wide notch, but on the convex side this is prolonged by a rather wide slit, about 1·0 mill. long. Length of shell 41, diameter of aperture 2·75, of apex 0·6 mill.; height of arch above the chord 3·75 mill. (*Dall*).

Off Cape Lookout, N. C., in 22–31 fms., sand; *off Hatteras, station 2276*, in 16 fms.; *and in the Gulf of Mexico*, in 26 and 111 fms., sand and mud (U. S. Fish Commission), also at *Samana Bay, Santo Domingo* in 16 fms., mud (Couthouy, in 1854).

D. matara DALL, Blake Rep., Bull. M. C. Z., xviii, p. 420 (1889); Bull. U. S. Nat. Mus., No. 37, p. 76.

Belongs to the same group as *perlongum;* there are no striæ near the apex as in *D. leptum*, which, moreover, is smaller and less colored. The apex has an unusually high "sheath" (figs. 16, 17, 18) in typical specimens, but in some there is only a very short one (figs. 14, 15). The color varies from a flesh tint to carnelian. Dall writes as follows:

This shell is colored like *D. rubescens*, but has a shorter and very different notch; is slimmer, straighter, and has a proportionally larger posterior end when perfect. It is less conical, less arched, and smaller than *D. callipeplum*, which it resembles in brilliancy. It entirely wants the fine posterior striation of *D. leptum* Bush, which is still more slender (*Dall*).

D. RUBESCENS Deshayes. Pl. 19, fig. 2.

Shell slender, moderately arcuate, but the bend mainly in the smaller third of the length, rather thin. Carnelian tinted, paler toward the aperture. *Surface smooth and glossy, with no longitudinal sculpture* and only faintly-indicated growth-lines. Aperture circular, the peristome thin and acute; anal orifice circular with thin margins, and on the convex side a short slit (or according to

Deshayes, an internal groove ending in a slight notch). Length 33, diam. 3·5 mill.

Mediterranean Sea, coasts of Italy, Sicily and Tunis, 2–40 fms.; *Canary Islands; Pliocene of Sicily.*

D. rubescens Desh., Mém. Soc. Hist. Nat. Paris, ii, p. 363, pl. 16, f. 23–25 (1825).—Phil., Enum. Moll. Sicil., i, p. 244 (1836) and ii, p. 206 (1844).—Aradas, Conch. Mar. della Sicil., p. 117 (1870).—Orb., Moll. Canaries, Brit. Mus. Catal., p. 28 (1854).—Dautzenberg, Mém. Soc. Zool. France, iv, p. 609.—Sowb., Thes. Conch., iii, pl. 224, f. 39.—Jeffreys, P. Z. S., 1882, p. 660.—Phil., Enum., i, p. 244; ii, p. 206.—*D. fissura* Phil., Enum. Moll. Sicil., i, p. 244. Not of Lamarck.—*D. rufescens* Weinkauff, Conchyl. Mittelm., ii, p. 420.—Clessin, Conchyl. Cab., p. 8, pl. 3, fig. 7 (bad).—*Pseudantalis rubescens* Monts., Nom. Gen. e Spec. Conch. Medit., p. 32.

The specimen before us has the apical features described above, but, according to Jeffreys, there is in perfect specimens "a small terminal pipe or sheath which is partly enclosed in the shell, but protrudes from it as in *D. entalis* and many other species; it is slightly channelled on each side. McAndrew noticed a white variety from Goletta near Tunis."

Varieties *pallida* and *albina* are mentioned by Monterosato.

Weinkauff changed the name to "*rufescens*," probably inadvertently; and Clessin, who appears to take all his synonymy at second hand, perpetuates the blunder, and wrongly quotes Philippi and others as using that incorrect name. He likewise places *D. filum* as a synonym of "*rufescens*" and admits it as a distinct species, on one and the same page of his unspeakable monograph.

Var. ? tenuifissum Monts. Pl. 19, figs. 16, 17.

Monterosato proposes the name *tenuifissa* for examples with a slit. The latter occur in the same localities with the unslit typical forms.

Deshayes also, in his ms. card catalogue, distinguishes this variation under the new name *D. discretum.*

Naples (Phil.) *to Sicily* (Phil., Monts.).

D. fissura Phil., Enum. Moll. Sicil., i, p. 244; ii, p. 206.—Costa, Fauna Reg. Nap., Tubibranchi, p. 25, pl. 3, f. 6. Not of Lamarck. *Pseudantalis tenuifissa* Monts., Nom. Gen. e Spec. Conch. Medit., p. 33 (1884).—*D. discretum* Desh., Mss.—*D. splendens* Costa, Catalogo ragionato, p. 125.

We scarcely endorse the view of Jeffreys, who seems not to have considered the slit form distinct. The somewhat meagre series of *D. rubsecens* seen (Jeffreys and Academy Coll.) is scarcely sufficient for definite decision. *D. fissura* Lamarck, with which Philippi and Costa identified this shell, is a Miocene species. *D. fissura* Sowerby may be a large, pale *D. splendidum*. See under *Fustiaria*.

D. MALZANI 'Dunker' Clessin. Pl. 19, fig. 3.

Shell slender, lightly curved, slowing increasing, smooth, somewhat solid, shining, semipellucid; white, with rose colored apex. Aperture round, margin acute; apex abruptly truncated. Length 33, diam. 3·5 mill. (*Clessin*).

Gorée, West Africa (Malzan).

D. malzani DKR. in Paetel's Catalog, p. 593 (no description).—CLESSIN, Conchyl. Cab., p. 42, pl. 11, f. 5 (1896).

Type in the Stuttgart Museum. Occurred with "*D.*" *goreanum*, a species of *Ditrupa* or some allied genus, which Clessin (in the year 1896! ! !) describes as a new *Dentalium*. How slowly moves this old World! *D. malzani* may be the same as *D. rubescens* Desh. No distinguishing characters have been brought forward.

D. SICULUM Deshayes, n. n. Pl. 19, fig. 6.

Shell cylindrical, somewhat curved, continuous, whitish, polished, with extremely close and delicate striæ. (*Costa*).

Adriatic Sea and Ionian Is. (Costa).

D. politum COSTA, Faun. Reg. Nap., Tubibranchi, p. 23, pl. 1, f. 4. Not *D. politum* Linn.—*D. siculum* DESH. in MS. card catalogue.

Costa describes the shell as smooth and lustrous, of a shining milk-white color, somewhat diaphanous, with fine circular striæ seen only under the lens, and indistinct annular swellings (such as occur in *D. eburneum*); and the apex is formed as in many Mediterranean tusk-shells, the orifice being small with thick walls and a slight notch, as shown in the figure. Length 1 inch, 6 lines. Deshayes gives no further information on his card, which is dated 1870, and probably had not seen the shell. Costa's species has been referred doubtfully to *D. rubescens* Dh. by some authors, but if the annulation described be really present, that species apparently is different.

D. LIODON Pilsbry & Sharp, n. sp. Pl. 21, figs. 37, 38, 39.

Shell moderately curved, rather slender, attenuated toward the apex, thin but not fragile. Subtranslucent bluish-white, opaque white

toward the middle, brilliantly polished. Sculpture none, except for occasional circular grooves indicating growth periods. Aperture subcircular, a little compressed between the convex and concave sides, not oblique. Anal orifice circular, with a narrowly v-shaped notch on the convex side (fig. 38). Length 25·3, greatest diameter 2, diam. of apex 0·6 mill.

St. Martin, West Indies (E. Marie).

The general appearance of the shell is like *D. semistriatum* Turton, but longitudinal striæ are wanting, and it is evidently allied to *D. translucidum* and other similar species here grouped. It differs from *translucidum, ambiguum, subtorquatum* and *lacteum* in having a well developed slit, among other less conspicuous features.

Var. ? *alloschismum* P. & S. Pl. 21, figs. 40, 41, 42.

Like the preceding, but the slit is on the concave side, either submedian (fig. 40) or to the side (fig. 41).

Length 24·5, diam. at aperture 1·9, at apex 0·6 mill.

Length 27·5, diam. at aperture 2·2, at apex 0·6 mill.

St. Martin (figs. 40, 40); *West Indies*, without nearer location (figs. 41, 42).

In view of the considerable variation observed in the position, shape and even presence or absence of the slit in other species, we hesitate to give this form rank higher than varietal. The section of the tube is circular in the variety, a little flattened in the type, but other characters seem identical. The specimen represented in figs. 41, 42 seems to be somewhat worn at the apex at the termination of the slit. The latter is decidedly excentric, fig. 41 being viewed directly upon the concave side.

D. BISINUATUM André. Pl. 19, figs. 7, 8.

Shell conic, perfectly circular in transverse section, little curved, thin, translucid, glossy, of a yellowish corneous color; with oblique, regular, fine transverse striæ. Aperture circular, a little oblique; peristome sharp, irregular. Apex with two small notches, one ventral, the other dorsal, a little deeper than the former. Length 33·5, diameter of the aperture 3, of apex 0·5 mill. (*André*).

Amboyna.

D. bisinuatum ANDRE, Revue Suisse de Zool. et Ann. du Mus. d'Hist. Nat. de Genève, iv, fasc. 2, p. 397, pl. 17, f. 9 (Dec., 1896).

This species is allied to *D. splendidum* Sow.; the size of the latter is greater, and the notches of the apex are continued in a slit

double the length of the notch. *D. bisinuatum* also approaches *D. erectum* Sow., Jr., but is smaller, more curved, and the posterior notch is not so deep. (*André*).

D. INSOLITUM E. A. Smith. Pl. 22, figs. 56, 57.

Shell slender, conspicuously arcuate, smooth, polished, subpellucid, white; with the tube hardly circular, being lightly flattened on each side. Striated with very delicate growth lines, hardly slit at the apex. Length 36, greatest diam. 2·5 mill. (*Smith*).

Bay of Bengal, in 597 fms. (Investigator).

D. insolitum SMITH, Ann. and Mag. N. H. (6), xiv, p. 168, pl. 4, f. 17, 17*a* (Sept., 1894).

The peculiarity of this species consists in its being a little compressed, so that the tube is not circular. It is broadest along the concave curve, which is not so round as the opposite side, and almost defined by lateral angles. (*Smith*).

D. DIARRHOX Watson. Pl. 3, figs. 36, 37, 38.

Shell white (chalky), but porcellanous beneath the surface, rather straight, with a considerable bend near the apex; of rather rapid expansion from a very fine apex. Sculpture: the whole surface is faintly marked with scarcely impressed longitudinal lines of very equal interval (about 0·0055 apart); transversely it is very faintly scratched all over by very slight lines, which run elliptically round the shell. The apex has a very narrow, slightly ragged fissure, about 0·027 inch long, which lies unsymmetrically on the convex curve. Length 0·6, breadth 0·09 inch. (*Watson*).

Animal: Mantle white, body pale yellow. Captacula many, fine, long and equal, with small ovoid points. Foot and collar those of a true *Dentalium*.

N.-E. from New Zealand, lat. 37° 34′ S., long. 179° 22′ E., in 700 fms. (Challenger).

D. diarrhox WATSON, Journ. Linn. Soc. Lond., xiv, p. 511 (1879); Chall. Rep., p. 4, pl. 1, f. 5.

This differs from *D. leptoskeles* Wats., in being more curved and more conical. It resembles in form the young of *D. lubricatum* Sowb. "from Australia," but in that the transverse striæ are much less oblique, and the surface is "lubricate" and polished. (*Watson*).

D. LEPTOSCELES Watson. Pl. 3, figs. 44, 45, 46.

Shell very attenuated, thin, brilliant, porcellanous, with longitudinal flecks of opaque white on the translucency of the shell, chiefly toward the apex, where the shell thickens, very little bent, very slightly compressed between the convex and concave curves. Sculpture: there is some kind of flexuous longitudinal texture in the structure of the shell affecting the reflection from the brilliant surface, which is also closely and regularly scratched transversely by very minute, sharp, but superficial lines, which run round the shell a little elliptically. Length 1·5, breadth 0·12, at apex 0·04 inch [37·5, 3 mill.]. (*Watson*).

Animal yellow, with a large dark patch in the region of the liver. A close little bunch of captacula round the mantle opening. (*Watson*).

S. of Australia, lat. 42° 42′ S., long. 134° 10′ E., in 2600 fms. (Challenger).

D. leptosceles WATSON, Journ. Linn. Soc. Lond., xiv, p, 513 (1879).—*D. leploskeles* WATSON, Challenger Rep., p. 7, pl. 1, f. 6.

This species in form very much resembles *D. erectum* G. B. Sow., British Museum "from Sydney," for while some specimens of that species are more curved than this, others are even less so; but in this species the transverse striæ are very much more oblique, and in the former there is no trace of the irregular intratextural longitudinal striæ which exist here. Than *D. agile* Sars, this is a straighter and much more cylindrical, attenuated, brilliant, and delicate shell. (*Wats.*).

D. LUBRICATUM Sowerby. Pl. 19, fig. 22.

Shell polished, elongate, white, subpellucid, lightly curved, slightly slit, gradually increasing. (*Sowb.*). Length 64, greatest diam. 6 mill. (from fig.).

Off Port Jackson Heads 45 fms. (Challenger); *Australia* (Sowerby).

D. lubricatum SOWB., Thes. Conch., iii, p. [95], pl. 225, f. 56 (1860); and in Conch. Icon., xviii, pl. 7, f. 55 (1872).—BRAZIER, Proc. Linn. Soc. N. S. Wales, ii, p. 370 (1878).

Certainly a narrower shell, less solid and of more gradual increase than either *D. entalis* or *D. pretiosum* (*Sowb.*). Brazier seems to have obtained a specimen dredged by the "Challenger" off Port Jackson.

D. ERECTUM Sowerby. Pl. 19, fig. 23.

Shell polished, narrow, slightly curved, reddish from the middle to the apex, white toward the aperture; slit on each side (*Sowb.*). Length 55·5, greatest diam. 3·9 mill. (from fig.). Length 1 inch (*Angas*).

Port Jackson, New South Wales, Australia (Strange; Angas).

D. erectum SOWB., Thes. Conch., iii, p. 99, pl. 225, f. 55 (1860); Conch. Icon., xviii, pl. 6, f. 41.—*Antalis erecta* ANGAS, P. Z. S., 1867, p. 220.—CLESSIN, Conchyl. Cab., vi, Heft x, p. 29, pl. 9, f. 1 (1896).

This tapering shell is very little curved; the narrow end is strongly colored, the larger end white. There is a slit on each side of the apex. (*Sowb.*).

An unusually straight species. It was dredged by Angas near the "Sow and Pigs" reef.

D. LONGITRORSUM Reeve. Pl. 20, figs. 35, 36.

Shell much and evenly curved, very long and slender, the length (of chord) about 19 times the greatest diameter; thin, but solid, polished, amber or carnelian colored or tinted, or pure white. Sculpture none, save inconspicuous growth lines. Aperture circular, the peristome thin. Anal orifice, circular, entire or ovate, and with a slight notch slightly aside from the middle on the convex side. Length 89, diam. of aperture 4·7, height of arch from chord 16 mill.

Darnley Island, Torres Straits 30 fms., sandy mud (Chevert Exped.); *west of Cape York, south-west of Papua*, 25 fms. (Challenger Exped.); *Bombay* (Melv. & Abercrombie); *Gulf of Suez* (Mac Andrew); *Philippines* (Sowerby; Phila. Acad. coll.); *Zanzibar and China* (Brit. Mus.).

D. longitrorsum REEVE, P. Z. S., 1842, p. 197; Conch. Syst., ii, p. 6, pl. 130, f. 6, (1842).—SOWERBY, Thes. Conch., iii, p. 98, pl. 225, f. 59, 60 (1860); and in Conch. Icon., xviii, pl. 2, f. 9*a*, *b* (1872).—WATSON, Journ. Linn. Soc. Lond., xiv, p. 515 (1879) and Challenger Scaphopoda, p. 9 (1885).—BRAZIER, Proc. Linn. Soc. N. S. Wales, ii, p. 59 (1877).—MELVILL & ABERCROMBIE, Mar. Moll. Bombay, Mem. & Proc. Manchester Lit. and Philos. Soc. (4), vii, p. 25 (1893).—COOKE, Ann. Mag. N. H. (5), xvi, p. 271.—*D. lamarckii* CHENU, Illustr. Conchyl., i, *Dent.*, p. 5. pl. 6, f. 15, 15*a*. —*D. longirostrum* PAETEL, Catalog, i, p. 593.

Easily recognized by its great length, strong curvature and brilliant polish.

Subgenus Rhabdus Pilsbry & Sharp, 1897.

Nearly straight or but slightly curved Dentalia, the shell very thin throughout and of somewhat glassy texture when unworn; the surface brilliant, polished, without longitudinal sculpture; both orifices simple, the smaller end without notch, slit or supplemental tube. Type *D. rectius* Cpr.

West coast of North and South America in deep water. A group of more curved species from the western Pacific may also form a section of this subgenus.

Key to species.

I. Shell with numerous annular swellings or low rings. Oriental.
  a. Length 12-13 times the diam., *eburneum*, p. 115.
  a'. Length 15 times the diam., *philippinarum*, p. 116.

II. Shell with dense, fine concentric striæ; white under a thin, fugitive light chestnut cuticle; length 45–50 mill., about 6 times the diam., *perceptum*, p. 115.

III. Shell unsculptured, smooth, the length over 10 times the diameter. West American.
  a. *Almost perfectly straight*, excessively slender, much attenuated; length 31·5 mill., about 19 times the diameter, *æquatorium*, p. 112.
  a'. Very slightly curved, almost straight; extremely slender but less attenuated posteriorly; length 29–31 mill., 16–19 times the diameter, *watsoni*, p. 113.
  a''. Very slightly curved, almost straight; length 30-40 mill., 12–16 times the diameter, *rectius*, p. 113.
  a'''. Slightly curved, less slender; length 45–70 mill., 11–14 times the diameter, *dalli*, p. 114.

Group of D. rectius.

D. æquatorium Pilsbry & Sharp, n. sp. Pl. 21, fig. 43.

Shell almost perfectly *straight, excessively slender*, regularly tapering and attenuated toward the apex, *thin and very fragile*, translucent and almost colorless except where whitened by erosion. *Sculpture none*, growth-striæ being nearly or quite invisible except where slight surface erosion has traced them. Aperture hardly oblique,

circular. Anal orifice circular, its edge in the type specimen jagged from breakage, but apparently without true slit or notch. Length 31·5, diam. at aperture 1·6, at apex 0·5 mill.

Off Manta, Ecuador, in 401 fms., bottom temperature 42·9° (U. S. Fish Commission, Station 2792).

No recent species known to us is so nearly straight as this. It is smaller at the apex and straighter than *D. watsoni*, which seems to be its nearest ally. *D. innumerabile* is another almost straight species, but it is smaller, colored and compressed, and belongs to an appreciably different group of species. *D. rectius* is like this in texture, but is of course very much less slender. The unique type is no. 122759, U. S. Nat. Mus.

D. WATSONI Sharp & Pilsbry, n. sp. Pl. 21, fig. 44.

Shell *very slightly curved*, long, *extremely slender*, not much tapering, thin, white; surface shining, *wholly free from longitudinal* sculpture, the growth-lines fine and inconspicuous. Aperture circular, hardly oblique. Anal orifice small and circular, simple; no slit or notch.

Length 31, diam. at aperture 1·6, at apex 0 75 mill.

Length 29·3, diam. at aperture 1·8 at apex 0·75 mill.

Off Tillamook Bay, Oregon, in 786 fms. (U. S. F. C., sta. 3346); *off San Diego, California* (U. S. F. C., Sta. 2923).

As straight as *D. rectius* Cpr., but very much more slender. It is more curved than the closely allied *D. æquatorium* from off Ecuador, and slightly larger at the aperture. The specimens are but slightly translucent, one being quite and the other almost opaque; but they are both dead shells, and may have been more transparent in life.

Types are nos. 107702 and 107706, U. S. National Museum. It is named in honor of the learned author of the 'Challenger' Report on *Scaphopoda* and *Gastropoda*.

D. RECTIUS Carpenter. Pl. 21, fig. 45.

Shell *almost straight*, slender and long, attenuated toward the apex, *thin and fragile*, bluish-white, somewhat translucent, with some opaque white flecks or rings, often encrusted near the aperture with a reddish deposit. *Surface very glossy, polished*, growth-marks being only faintly seen, and sculpture absent. Aperture not oblique, almost circular, but the tube is a little compressed laterally; peristome thin. Apical orifice small, circular, without notch or slit, but from its extreme fragility the end is often nicked or broken.

Length 40, diam. at aperture 2·6, at apex 1 mill.

Length 30, diam. at aperture 2·5, at apex 0·6 mill.

Near Victoria, Vancouver Id., 60 fms. (Newcombe); *Puget Sound* (Kennerley, and U. S. F. C. in 82–135 fms.); *off Tillamook Harbor, Oregon*, 786 fms.; *California, off Point Reyes*, 50 fms., *off Bodega Head*, 62 fms., *off Cortes Bank*, 984 fms., *Santa Barbara channel*, 205–233 fms., *Monterey Bay*, 13 and 37 fms. (U. S. Fish Commission).

D. rectius Cpr., Rep. Brit. Asso. Adv. Sci., for 1863, pp. 603, 648 (no description); Proc. Acad. Nat. Sci. Phila., 1865, p. 59.—Newcombe, Nautilus x, p. 18.—Taylor, Trans. Roy. Soc. Canada (2), i, p. 56.

Allied to *D. watsoni* and *D. æquatorium*, species decidedly more slender, and to *D. dalli*, a stouter, larger, more curved species. The whole series is remarkable for the tenuity of the smooth shell, and its unusual straightness. The specimen figured is no. 107707, U. S. Nat. Mus., from Monterey Bay, 37 fms. Carpenter's type was from Puget Sound, and measured 1·9 inch. in length.

D. dalli Pilsbry & Sharp, n. sp. Pl. 21, fig. 46.

Shell regularly but only slightly curved, evenly tapering, *thin and fragile;* opaque, slightly bluish-white. Surface brilliant, glossy and polished; but in all specimens seen, *mainly dead or lusterless whitish, from loss of the greater part of the superficial gloss, which remains near the aperture only*, or sometimes in patches or irregular rings elsewhere. *Growth-striæ faint; no other sculpture.* Aperture circular, not oblique. Apex rather large, with simple, circular, thin-edged orifice; no slit or notch.

Length 45. diam. at aperture 4, at apex 1·5 mill. (type).

Length 50, diam. at aperture 3·8, at apex 1·5 mill. (Bering Sea).

Length 69, diam. at aperture 4·9, at apex 2·5 mill. (Acapulco).

Bering Sea, N. of Unalashka, 351 fms., *Chernoffski, Unalashka*, 109 fms., *and off Illinlink Harbor*, 309 fms. *Off Tillamook Bay, Oregon*, 786 fms. *Off Point Conception, California*, 278 fms., *and Sta. Barbara Channel*, 265 fms. *Off Acapulco, Mexico*, 660 fms., bottom temp. 39°. (U. S. Fish Commission).

This species is most nearly related to *D. rectius* Cpr., but it is larger, less slender and more curved. The outer varnish or gloss seems to be caducious, and is largely lost, leaving a mat white surface, in the specimens seen. *D. pretiosum* often occurs with almost

exactly the size and figure of *D. dalli*, but it is a very solid shell, while our new form is one of exceptional fragility, and moreover lacks the apical striation of young *pretiosum*.

The range of Dall's tusk-shell extends in deep water the entire length of the North American continent, though apparently more numerous in the north. We have distinguished it by a specific name which so long as West Coast shells are studied, will be an honored one among naturalists.

Imperfect specimens, apparently of this species, were obtained by the Fish Commission in the Gulf of Panama. Types are no. 107696 U. S. Nat. Mus.

Group of D. perceptum.

D. PERCEPTUM Mabille & Rochebrune.

Shell rather straight, scarcely incurved, densely concentrically striated, slowly increasing. White, under a caducious bright chestnut epidermis; diaphanous, fragile, scarcely shining, apex entire, nearly tubular. Length 45–50, greatest diam. 8 mill. (*M. & R.*).
Cape Horn.

Dentalium perceptum MAB. & ROCH., Miss. Sci. Cap Horn, vi, Zool., Moll., p. 99 (1889).

An elongated, straight shell, presenting somewhat of a very noticeable curvature, delicately ornamented with fine concentric striæ, and pure white under a fugitive, very light chestnut epidermis; diaphanous, fragile, without luster, and of slow increase; the summit entire, a little in the shape of the mouth of a huntsman's horn. (*M. & R.*).

Group of D. eburneum.

Shell thin, moderately or slightly curved, glossy, with numerous unequal coarse annular wrinkles; anal orifice simple.

D. EBURNEUM Linné. Pl. 20, figs. 33, 34.

Shell long and slender, moderately arcuate, attenuated posteriorly, the length about 12½ times the diam.; rather thin; white, shining. *Sculpture of numerous, unequal, irregularly spaced encircling ribs, rather low and rounded*, with fine growth-lines throughout; sometimes showing traces of longitudinal striation in places. Aperture subcircular or rounded-ovate, narrower toward the concave side; peristome thin. Anal orifice small, rounded-oval, the greatest diameter antero-posterior; a slight notch on the convex side or none.

Length 59, antero-posterior diam. apert. 4·7, lateral diam. 4·5; diam. apex 0·9 mill.

Length 66, diameters of aperture 5·3, of apex 0·9 mill.

Singapore (Dr. S. Archer); *Sullivan Island, Mergui Archipelago,* in 7 fms. (Anderson); Also *Siam and Philippine Is.* (authors).

D. eburneum Linn., Syst. Nat. (12), p. 1264 (1767).—Gmelin, p. 3737.—Lam., An. s. Vert., v, p. 346 (1818).—Hanley, Ipsa Linnei Conchylia, p. 438 (1855).—Sowb., Thes. Conch., iii, p. 98, pl. 225, f. 53 (1860); and in Conch. Icon., xviii, pl. 3, f. 16 (1872). —Martens, Journ. Linn. Soc. Lond., Zool., xxi, p. 200. Not *D. eburneum* Desh., 1825,=*politum* Linn.—*D. politum* Mawe, The Linn. Syst. Conch., p. 191, pl. 33, f. 6 (1823).—Crouch, Illustr. Introd. Lam. Conch., p. 1, pl. 1, f. 2 (1827).—? Desh., Mém. Soc. H. N., Paris, ii, p. 361, pl. 16, f. 17 (1825), and in Lam., An. s. Vert. edit. 2, v, p. 597. Not *D. politum* Linné.—*D. indicum* Chenu, Illustr. Conchyl., i, *Dentalium*, p. 4, pl. 3, f. 11.—*D. annulare* G. B. Sowerby, Zool. Journ., iv, p. 199 (1828).

D. eburneum of nineteenth century authors before 1855 is *D. politum* Linn. as Hanley has shown. The species is remarkable for its irregularly placed, low, swollen rings. All of the specimens before me with definite and reliable locality data, are from Singapore.

D. philippinarum Sowerby. Pl. 20, figs. 31, 32.

Shell similiar to *D. eburneum*, but less curved, less tapering, the posterior end being larger and the aperture smaller than in specimens of *eburneum* of the same length; polished, with low, irregular variceal rings and some circular impressed lines, and showing distinct traces of longitudinal striation in some places. Translucent whitish.

Length 56, diam. of the subcircular aperture 3·7, of the apex 1·3 mill.

Island of Samar, Philippines (Cuming).

D. philippinarum Sowb., Thes. Conch., iii, p. 98, pl. 225, f. 54 (1860); and in Conch. Icon., pl. 3, f. 18 (1872).

This tusk-shell is evidently very closely allied to *D. eburneum*, but our material does not permit us to unite the two, although it is not improbable that intermediate specimens will be found. Sowerby thus describes it:

Shell elongated, very narrow, rather straight, semipellucid, highly polished, somewhat golden brown, banded with numerous elevated

concentric rings. Apex attenuated; apical fissure very short. (*Sowb.*).

Narrower than *D. eburneum*, more diaphanous, and of a reddish color. This is a brightly colored, transparent shell, much narrower in proportion than *D. eburneum*. (*Sowb.*).

Length 52, greatest diam. 4 mill. (from fig.).

Subgenus EPISIPHON Pilsbry & Sharp, 1897.

Small, very slender, rather straight shells, needle-shaped or truncated, slightly tapering, thin and fragile, glossy and smooth, or at least without longitudinal sculpture; apex with a projecting pipe or a simple orifice; no slit, rarely a notch.

Inhabitants of moderately or very deep water in the Mediterranean, Atlantic, Gulf of Mexico and Pacific.

The small accessory tube or pipe at the apex is frequently developed in most, perhaps all, of the species grouped here; although most young and many adult shells lack it. The majority of the species are known by but few specimens, but in *D. filum* and *D. innumerabile*, of which we have seen a good many hundreds, the specific characters though not very conspicuous or strongly marked, seem very constant.

Key to species.

I. Aperture oval, the tube laterally compressed; salmon colored, *innumerabile*, p. 119.

II. Aperture circular.

a. Shell decidedly curved, white or fulvous; length 18, diam. 1·2 mill., *longum*, p. 120.

a'. Shell nearly straight.

b. Decidedly tapering, acicular, *subrectum*, p. 119.

b'. Subcylindrical, usually with an accessory apical tube in adults, nearly smooth, *sowerbyi*, p. 117; *filum*, p. 118; *fistula*, p. 118.

b''. Upper part of tube encircled by deep, close-set grooves; an apical tube developed; length about 13 mill., *tornatum*, p. 121.

D. SOWERBYI Guilding. Pl. 20, fig. 30.

Shell small, nearly smooth, transversely indistinctly subplicatulate, the apex bearing a tube. Length 13 mill. (*Gldg.*).

Caribbean Sea.

D. sowerbyi GUILDING, Trans. Linn. Soc. Lond., xvii, p. 35, pl. 3, f. 7 (1834).

Known only by Guilding's description and figure.

The relation of this form to *D. fistula* and *D. filum* requires investigation; but as only the last named of these species is known to us by specimens, we deem it best to present the information upon all three, unprejudiced by an attempt at synonymy.

D. FISTULA Sowerby. Pl. 18, fig. 4.

Shell subhyaline, narrow, nearly straight, the apex entire. (*Sowb.*). Length 21 mill. (from figure).

Habitat unknown (Hanley coll.).

D. fistula SOWB., Thes. Conch., iii, p. 99, pl. 225, f. 62, under f. 45 (1860).

Mr. Sowerby seems to consider this doubtfully distinct from *D. duplex* Defr., of the Paris Basin Eocene, but in that species the tube is compressed and provided with two internal ribs. Deshayes in his MS. catalogue places *fistula* under *D. sowerbyi* Guilding. We have seen no specimen.

D. FILUM Sowerby. Pl. 18, fig. 9.

Shell *extremely narrow and slender*, gently curved, thin, nearly transparent and glossy. Sculpture: slight concentric lines of growth, which are scarcely perceptible; color clear white. *Aperture circular;* margin at the anterior end more or less jagged, owing to its excessive tenuity and fragility; at the posterior end truncated, *with an internal pipe* (in adult shells) and slightly notched; in the fry this latter part has a pear-shaped and perforated point. Length 12½, breadth 1¼ mill.

Mediterranean, from the Ægean (*off Crete* 70–250 fms., Spratt), *and Algeria to Gibraltar* (MacAndrew); *E. Atlantic, Vigo* (MacAndrew); *Bay of Biscay* (Travailleur). *Off North Carolina coast* 17–124 fms. (U. S. Fish Comm.); *older Miocene of the Chipola Beds, Calhoun Co., Florida* (Burns); *Pliocene of Calabria* (Seguenza).

Dentalium sp. ined., very slender, MACANDREW, Rep. Mar. Test. Moll. N.-E. Atl., in Rep. Brit. Asso. Adv. Sci. for 1856, p. 117.—*D. filum* SOWERBY, Thes. Conch., iii, p. 89, pl. 225, f. 45, Gibraltar specimens only, (1860); Conch. Icon., pl. 5, f. 31 (not fig. 32).—JEFFREYS, P. Z. S., 1882, p. 660.—HIDALGO, Catal. Moll. Espagne,

p. 148.—Dall, Blake Rep. Bull. M. C. Z., xviii, p. 419 (1889); Bull. 37, U. S. Nat. Mus., p. 76; Trans. Wagner Inst., iii, p. 441 (1892).—*D. gracile* Jeffreys, Ann. Mag. N. H. (4), vi, p. 74 (July, 1870), and (5), vi, p. 317 (1880). Not of Meek.—Fischer, Journ. de Conchyl., 1872, p. 140, pl. 5, f. 5.—*D. rufescens* (in part) Weinkauff, Conch. des Mittelm., ii, p. 420.

Fully mature shells are nearly cylindrical, the truncated and often tubiferous apex almost as wide as the larger end; the young are acicular, tapering. Color either white or faintly fulvous. Jeffreys writes: "Mr. McAndrew tells me that the animal was of a greenish color. Not the young of *D. rubescens*. The present species is more regularly cylindrical, narrower and nearly equal in breadth throughout. It is curved, which shows that it is adult, the very young of all species of *Dentalium* being almost straight."

D. innumerabile Pilsbry & Sharp, n. sp. Pl. 18, figs. 6, 7, 8.

Shell small, but slightly curved, *excessively slender*, and in adults only slightly tapering; thin and fragile, glossy, *the smoothness of the polished surface scarcely interrupted by delicate faint growth striæ; no other sculpture. Flesh or salmon colored*, fading into translucent white near the aperture, and often with some oblique white rings at irregular intervals. *Aperture oval, the tube being compressed laterally.* Anal orifice circular, occupying a small and short projecting pipe in most adults, but this is very short or wanting in some examples. Length 17, antero-posterior diam. of aperture 0·8, lateral diam. 0·7 mill.; diam. at apex 0·6 mill.

Panama Bay in 26, 29½ and 51 fms.; *off Guaymas* in 20 fms.; *off Lower California near Sta. Margarita Island, lat. 24° 32′, long. 111° 59′* in 12 fms.; *and near Cerros I., lat. 28° 12′, long. 115° 9′*, in 44 fms. (U. S. Fish Commission Str. 'Albatross').

Like *D. sowerbyi, filum* and *fistula*, but the tube is distinctly, though not much, compressed from side to side. It occurred in great numbers in the Bay of Panama. *D. ottoi* Sharp & Pilsbry (*D. compressum* O. Meyer, not Orbigny), is evidently a closely allied species from the Oligocene of Joachimsthal, Germany. Immature shells are more tapering, being smaller toward the apex, as usual.

D. subrectum Jeffreys. Pl. 18, fig. 5.

Shell acicular or needle-shaped, thin, extremely slender, tapering almost to a point, nearly straight, translucent whitish, with the faintest reddish tint from the middle to the apex. Surface very

glossy, smooth, with faint growth-striæ only. Aperture not oblique, circular. Anal orifice minute, circular, with thin, entire edge. Length 16, diam. of aperture 1 mill.

Philippines (Cuming).

D. subrectum JEFFREYS, P. Z. S., 1882, p. 661 (artfully concealed in the text under *D. filum*).—*D. filum* in B. M., and, in part, of Sowerby.

This form was considered by Sowerby the same as that he had described from Gibraltar as *filum;* but Jeffreys has indicated the differences recited below, which we have confirmed. Figured and described from the type, a specimen in Jeffreys' collection, now in U. S. National Museum.

Longer and proportionally broader toward the front or anterior end than *D. filum* [*gracile* Jeffr.], and consequently less slender and thread-like; also more curved.

D. LONGUM Sharp & Pilsbry, n. sp. Pl. 18, figs. 1, 2, 3.

Shell slender, the length about 15 times the greatest diameter, moderately tapering, rather strongly curved, in section circular. Surface glossy, whitish, somewhat translucent. Sculpture: faint fine growth-striæ throughout, running circularly around the tube; no longitudinal striæ. Aperture circular, not oblique (fig. 3). Apical orifice circular, with thin walls and a wide shallow notch on the convex side (fig. 1). Length 18·1, diam. at aperture 1·2, at apex 0·5 mill.

Habitat unknown (type no. 71080, coll. A. N. S. P.).

D. longum is decidedly more curved than *D. fistula, sowerbyi, filum, innumerabile* or *subrectum;* and in place of the apical supplemental tube generally developed in adult individuals of the former four of these, our new species has an open anal orifice with a wide, shallow notch or emargination on the convex side.

D. attenuatum of Sowerby, 1860 (but not *D. attenuatum* Say, 1824), is probably the same specifically, although as we have not had the advantage of comparing the type of that form, no positive statement can be made. The original figures and description are here given, together with some additional information obligingly furnished by Mr. Sowerby.

D. attenuatum (pl. 20, fig. 28). Shell thin, tawny, polished, a little arcuate, narrower than *D. inversum;* apex slightly emarginate. A shining, pointed, very narrow species, with a very slight

notch at the apex. It is nearly straight. (*Sowb.*, Thes. Conch., iii, p. 99, pl. 225, f. 40, 1860; Conch. Icon., xviii, pl. 5, f. 32 (not f. 31).

Length 29, greatest diam. 1·6 mill. (from figure).

It is fulvous, shining, semipellucid, larger and more curved than *D. filum*. The figures of this species and *D. filum* were inadvertently transposed in the Conchologia Iconica. (*G. B. S.* in letter).

D. TORNATUM Watson. Pl. 3, figs. 39, 40, 41.

Shell small, narrow, very finely tapering, slightly, but very equably bent, strong, of a quill-like translucency and brilliance. Sculpture: the upper part of the shell is encircled by deep, close-set, slightly oblique grooves, which look as if they were turned in a lathe. Farther down the shell they become shallower, and cease at last rather abruptly. The flat bands of the shell-surface which part them are of variable widths, and increase with the growth of the shell from about 0·011 inch to twice that amount. The front part of the shell is closely, minutely, obliquely striated in the line of growth, with here and there a very faint depression, just suggestive of the grooves above. There is besides these a faint, transverse flocculence in the substance of the shell. Mouth edge thin, not contracted, very slightly oblique. The apex is abruptly broken across, and there the edge of the shell is thick, and from the opening there projects a minute, round pipe about 0·008 broad and 0·012 long, slightly striated obliquely, abruptly broken off at the end. In most of the specimens only the mere stump of this delicate tube remains. Length 0·55, breadth 0·038, apex 0·018 inch (*Watson*).

Levuku, Fiji, 12 fms. (Challenger).

D. tornatum WATS., Journ. Linn. Soc. Lond., xiv (1879); Chall. Rep., p. 13, pl. 2, f. 3.

This species seems to vary a little in breadth (*Watson*).

Subgenus BATHOXIPHUS Pilsbry & Sharp, 1897.

Shell thin, *conspicuously compressed laterally*, nearly or quite smooth, with a broad slit on the convex side of apex.

D. ENSICULUS Jeffreys. Pl. 7, figs. 7, 8, 9, 10.

Shell tapering, considerably and regularly curved throughout or with the latter half nearly straight. *Laterally compressed or flattened;* thin, nearly transparent, and glossy. Sculpture: *a sharp keel on both the dorsal and ventral sides* (giving the appearance of a

double-edged scimitar), becoming blunter toward the aperture in adults, besides occasionally a few slight, irregular, longitudinal keels or raised striæ and concentric lines of growth. Color, clear white. Slit of moderate length and very broad, semicylindrical, placed on the convex side. The slit cuts away about half of the posterior or narrow end of the shell. Length 27½, antero-posterior diam. of aperture 2, lateral diam. 1·3 mill.; Jeffreys' type was smaller, length 0·9, breadth 0·1 inch.

North Atlantic, 1450–1785 fms.; *West of Ireland*, 1366 fms.; *Bay of Biscay*, 862 fms.; *Portugal*, 740–1095 fms. (Jeffr.). *S.-W of Nantucket*, 1825 fms.; *off Chesapeake Bay, etc.*, 1594 fms. (U. S. Fish Comm.). *Yucatan Strait*, 640 fms.; *near St. Vincent*, 464 fms.; *off Barbados*, 399 fms. (Blake). *Yucatan Strait*, in 1060 fms., *and off Havana*, 1024 fms. (Dr. W. H. Rush). *Off Cape Florida*, 193 fms.; *off Sombrero Island*, 450 fms. (Challenger). *N. of Culebra Island* (Challenger, for *D. didymum* Wats.).

D. ensiculus Jeffr., Ann. Mag. N. H. (4), xix, p. 154 (1877); P. Z. S., 1882, p. 660, pl. 49, fig. 4.—Watson, Challenger Rep., p. 12, pl. 2, f. 2.—Verrill, Trans. Conn. Acad., vi, p. 432 (1885).—Dall, Blake Rep., Bull. M. C. Z., xviii, p. 428, pl. 27, f. 12; Bull. U. S. Nat. Mus., No. 37, p. 76; Proc. U. S. Nat. Mus., xii, p. 294.—*Dentalium sigsbeanum* Dall, Bull. M. C. Z., ix, p. 38 (1881).—*D. didymum* Watson, Journ. Linn. Soc. Lond., xiv, p. 517 (1879); Chall. Rep., p. 10, pl. 1, f. 11.

Easily recognized by the strongly compressed form. Comparison of a full series by W. H. Dall rendered the above consolidation necessary.

Mr. Smith has placed on record (Proc. Malac. Soc. Lond., i, p. 60) a list of characteristically North Atlantic mollusks, believed to have been dredged by the "Challenger" at Station 164, off Sydney, N. S. Wales, in 410 fms., including the following Scaphopods: *Dentalium ensiculus*, *D. panormitanum* [*panormum*] Chenu, *D. capillosum* Jeffr., and *Cadulus propinquus* Sars or *C. curtus* Jeffr., the first two positively identified, the others not absolutely certain, though probably correct. Taking into account the association of species of other genera, it seems to us quite incredible that these forms actually occurred at the Station alleged. It is far more likely that a locality label became misplaced.

Var. DIDYMUM Watson. Pl. 7, fig. 20.

Shell extremely attenuated, very slightly curved, a little flattened laterally, and that chiefly towards the convex curve, so that the form is slightly trigonal, porcellanous, pure white, brilliant. Sculpture: very fine, irregular scratches run around the shell, the surface of which is not perfectly uniform; there are very faint indications of longitudinal texture, and there is in the substance of the shell a certain transverse flocculence. Towards the mouth the shell is extremely thin as usual; but towards the apex it becomes thick from the smallness of the bore, which lies not in the center, but nearer the convex curve of the shell. Length 1·08, breadth 0·6, at apex 0·04 inch. The measurement is taken from the largest of six fragments, none of which preserve the apex of the shell (*Watson*).

This may be a variety, distinguished by the slightly trigonal or ovate section, typical *ensiculus* being regularly, symmetrically elliptical at the aperture, as shown in fig. 7.

Subgenus COMPRESSIDENS Pilsbry & Sharp, 1897.

Shell small, decidedly tapering, conspicuously *compressed between the convex and concave sides;* weakly sculptured, nearly smooth; anal orifice simple, without slit or notch. Type *D. pressum* Sharp & Pilsbry.

The few species of this well-defined group inhabit widely separated areas. *D. pressum* and *ophiodon* are Antillean, *D. brevicornu* west American, and *D. platyceras* Australian. The occidental forms live in deep water. Specimens of all of them have been examined in the preparation of the following pages. The figures on plate 22 are from camera lucida drawings, representing concave and lateral aspects of each species.

An Oligocene member of the group is *D. præcursor* Pilsbry & Sharp from San Domingo. It was probably an ancestor of the recent American species.

Key to Species.

I. Shell but slightly curved, strongly compressed.

a. Length about 9·5 mill., about 4 times the greatest diameter; Panamic, *brevicornu*, p. 125.

a′. Length 11–13 mill., about 6 to 7½ times the greatest diameter; Antillean, *pressum*, p. 124.

II. Shell strongly curved, but little compressed, densely obliquely striated, the length 8·5 mill., about 4½ times the greatest diameter, West American, *simplex*, p. 125.

III. Shell decidedly curved, length 9 to 9½ times the greatest diam.,

a. Length 12–16 mill., faintly finely striate longitudinally; Antillean. *ophiodon*, p. 126.

a'. Length 11 mill., circularly wrinkled; Australian, *platyceras*, p. 126.

D. PRESSUM Sharp & Pilsbry, n. n. Pl. 22, figs. 50, 51, 52; pl. 7, fig. 11.

Shell small, slightly and evenly curved, thin, considerably tapering, the tube strongly compressed between its convex and concave sides, almost subangular on the lateral sides. White, somewhat shining. Sculpture: faint, low, regular, longitudinal riblets with very shallow intervals, crossed at right angles by close, "sharp, irregular scratches in the line of growth," bent forward on the concave side of the tube, which is also faintly wrinkled in the same direction toward the larger end. Aperture decidedly oblique, oval, the arc along the concave side generally less curved than the rest of the peristome. Apical orifice oval, without slit or notch.

Length 12, greatest diam. of aperture 2, least 1·75 mill., diam. at apex 0·75 mill. (S. & P. type).

Length 0·45, greatest diam. at aperture 0·06, least 0·05 inch., diam. at apex 0·019 inch = 11·25, 1·5, 1·25, 0·475 mill. (Watson's type).

N. of Culebra Island, West Indies, 390 fms. (Challenger). *Off Cape San Antonio*, in 413 fms.; *near St. Vincent*, in 424 fms. (Blake). *Gulf of Mexico between Mississippi River delta and Cedar Keys, Fla.*, 111 fms. (Albatross). *Thirty-three and one-half miles S. of Rebecca Shoal, lat. 24° 02′ N., long. 82° 31′ 30″*, 430 fms. (Dr. W. H. Rush).

D. compressum WATS., Journ. Linn. Soc. London., xiv, p. 516 (1879); Chall. Rep., p. 9, pl. 1, f. 9.—DALL, Bull. M. C. Z., ix, p. 38 (1880); Ibid., Blake Rep., p. 426; Bull. U. S. Nat. Mus., No. 37, p. 76. Not *D. compressum* ORB., Prodr. Paléont. Strat., i, p. 233, no. 135 (1850).

As Dall remarks, the posterior half of well-preserved specimens is coarsely obscurely striated. This is variable, however, in specimens of the same age and condition, and sometimes almost imperceptible.

The *strong compression from concave to convex sides* is a very conspicuous feature of the species. In a section of the tube the arc along the concave side is much less curved than the other. The peculiar "texture of the shell which thus seems to be built up of minute, square-faced rods laid side by side," as Watson describes it, is not noticeable in the specimens before us.

The calibre of the tube increases more rapidly than in the closely allied *D. ophiodon* Dall, and it is more compressed.

D. BREVICORNU Sharp & Pilsbry, n. sp. Pl. 22, figs. 53, 54, 55.

Shell small, moderately curved, strongly compressed between the convex and concave faces, rapidly tapering, thin, buff-white. Sculpture: rather inconspicuous growth-lines and wrinkles, and excessively shallow, hardly noticeable traces of longitudinal depressions scarcely to be called sulci. Aperture not oblique, irregularly ovate, the outer margin rounded, inner much flattened. Apex not very small, its orifice rounded-oval. Length 9·5, transverse diam. of aperture 2·2, diam. from convex to concave sides 1·7 mill., greatest diam. at apex 0·7 mill.

Near Galapagos Is., 634 and 812 fms., bottom temp. 40°; *off Mazatlan*, 995 fms. (U. S. Fish Commission).

Very closely allied to the Antillean *D. pressum* Sharp & Pils., but the tube increases more rapidly in calibre and is decidedly less compressed on the outer curve. Type is No. 122809, U. S. Nat. Mus., from the locality first mentioned above.

D. SIMPLEX Pilsbry & Sharp, n. sp. Pl. 27, figs. 88, 89.

Shell short, decidedly curved, the bend mainly in the posterior half, *very rapidly enlarging*, tapering regularly from the large aperture to the apex; thin, bluish-white, a little translucent, more or less flecked with opaque white (by incipient surface decay), or with eroded spots. Glossy, with close, fine, distinct growth-striæ, very obliquely passing around the tube, bending backward on the convex, forward on the concave side; in most specimens also showing faint, low traces of longitudinal cords on the convex side. Aperture somewhat wider than long, quite oblique, the peristome thin. Anal orifice circular, simple when perfect, but often with irregular, broken edge. Length 8·6, diam. at aperture antero-posteriorly 1·75, laterally 1·9 mill.; diam at apex 0·7 mill.

Off Tillamook Harbor, Oregon, in 786 fms. (U. S. Fish Commission).

Less compressed and much more arcuate than *D. brevicornu*, and more distinctly striated circularly. It tapers more rapidly than *D. pressum* and is less compressed. *D. ophiodon* and *D. platyceras* are conspicuously slenderer. The longitudinal cords are variable in prominence, sometimes hardly noticeable. When well developed they are rather coarse, and of the same character as in *D. pressum*. Type no. 107700 U. S. Nat. Mus.

D. OPHIODON Dall. Pl. 7, fig. 13; pl. 22, figs. 61, 62.

Shell considerably curved, thin, slowly tapering, strongly compressed between the convex and concave sides. Grayish-white, somewhat glossy. Sculpture: faint, fine irregular longitudinal striæ with very superficial interstices, crossed by fine irregular growth-striæ and wrinkles, which bend forward on the concave side. Aperture irregularly oval, oblique, the peristome less curved along the concave side. Apex oval. anal orifice simple, unslit.

Length 15·5, greatest diam. at aperture 1·75, least 1·5 mill.

Length 12·5, greatest diam. at aperture 1·3, least 1·1, diam. at apex 0·27 mill.

Barbados in 100 fms. (Hassler Exped.); *Blake stations 19–21*, in 220–310 fms; *10 miles off Cuba, lat. 22° 38′ 40″, lon. 82° 28′* in 780 fms. (Dr. Wm. H. Rush).

D. ophiodon DALL, Bull. M. C. Z., ix, p. 427 (1881); Ibid., xviii, Blake Rep., p. 427, pl. 26, f. 9 (1889); Bull. U. S. Nat. Mus., no. 37, p. 76, pl. 26, f. 9.

The tube increases less rapidly in width than in *D. pressum*, it is decidedly more curved, and the longitudinal sculpture is finer and fainter. Dall writes as follows:

"About the same length as the last species (*D. pressum*), more slender, more acute, more translucent, more curved, and without the evanescent indications of longitudinal striation; the compression results in less tendency to angulation, and there is an evident tendency, in adult specimens, for the diameter at the mouth to be somewhat less than at a short distance behind it,—a very marked distinction as between the two. The shell is quite translucent, and very thin; there is very little variation between the specimens.

"The flattening is most prominent a little way behind the mouth in the adult, and is best seen in an adolescent specimen."

D. PLATYCERAS Sharp & Pilsbry, n. sp. Pl. 22, figs. 58, 59, 60.

Shell small, slightly curved, strongly tapering, dull, glossy toward the aperture, white. Sculpture of rather irregular and *decidedly*

oblique encircling wrinkles (sometimes indistinct from superficial erosion), obsolete toward the aperture where there are fine growth striæ only; *no longitudinal sculpture. Aperture very oblique, oval, wider than long;* the peristome thin and fragile. Anal orifice circular and simple.

Length 11, antero-posterior diam. of aperture 1·1, right to left diam. 1·25 mill.

Port Stephens, New South Wales, Australia (John Brazier).

Allied to *D. pressum* and *D. brevicornu* Pils. & Sharp. It is smaller and less compressed on the inner curve than the former, with no trace of longitudinal sculpture and more oblique growth-striæ.

Subgenus Fustiaria Stoliczka, 1868.

Fustiaria Stol., Mem. Geol. Surv. India, Cretaceous Fauna of Southern India, ii, p. 439; types *D. eburneum* Lam. and *circinatum* Sowb. (1868).—*Pseudantalis* Monterosato, Nomencl. Gen. e. Spec. Conch. Medit., p. 32, for *fissura* Lam., *inversum* Dh., *rubescens* Dh., *tenuifissa* Monts. and *filum* Sby. (1884).

Shell regularly tapering, arcuate, polished; either smooth or sculptured with regular encircling grooves, dividing the surface of the tube into short oblique segments. Aperture circular. Anal orifice round or ovate. *Slit a very long, straight, linear cleft* on the convex side. Type *D. circinatum* Sowb.

Soft anatomy unknown. Species Eocene to recent.

Some recent authors have treated this group as of generic value; but unless we dismember *Dentalium* and recognize a dozen or more genera in its stead, we are obliged to rank *Fustiaria* as a subgenus. The more conservative course has been chosen because the anatomical characters of Scaphopods are still but little known; the study of the class is in its infancy. Those who come after, when scalpel and microtome have given their testimony, will be better able to decide upon the true generic groups of the *Scaphopoda*, than we are now, when the soft anatomy of but a handful of species belonging to two or three of the groups has been worked out.

But one or two living species of *Fustiaria* are known; but there are numerous Tertiary forms, and perhaps some from the Cretaceous.

I. Shell annulated, *D. politum.*
II. Shell smooth, *D. stenoschizum, D. tenuifissum.*

D. POLITUM Linné. Pl. 19, figs. 18, 19, 20, 21.

Shell slender, long, slowly tapering and regularly arcuate, polished. Sculptured with many narrow encircling grooves, parallel with the peristome, and dividing the surface into narrow, oblique segments. Aperture somewhat oblique, circular, the peristome acute. Anal orifice rounded-ovate, somewhat channelled within at the position of the slit. Slit an extremely narrow and long cleft on the convex side.

Length 58, diam. aperture 4·9 mill.

Length 39, diam. aperture 3·3 mill.

Paris Basin Eocene at Grignon, etc.; recent in Indian Seas (Desh., Hanley).

Dentalium politum LINNE, Syst. Nat. (12), p. 1264 (1766).—HANLEY, Ipsa Linn. Conch., p. 438 (1855); SOWERBY, Thes. Conch., iii, p. 99, pl. 225, f. 46; Conch. Icon., pl. 6, f. 38 (1872).—*D. eburneum* SOWB., Genera of Shells, *Dentalium*, f. 6.—DESH., Mém. Soc. Hist. Nat. Paris, ii, p. 368, pl. 17, f. 8, 9 (1825); An. s. Vert. Bassin Paris, ii, p. 215, pl. 2, f. 11–13 (1864). Not *D. eburneum* L.—*D. subeburneum* ORB., Prodr. de Paléont., ii, p. 372 (1850).

This species is closely allied to *D. circinatum* Sowb., but is less slender. The two were formerly united by Deshayes, and Newton (Brit. Oligocene and Eocene Moll., 1891) still includes both under *circinata*. Whether the Eocene and living specimens referred to *D. politum* are identical is a question we have no means of answering, as we have seen no recent specimens. It is admitted to the modern fauna on the authority of Deshayes and Sowerby who state that they have examined oriental recent shells, although the former in his Paris Basin Invertebrates (p. 216) thinks that Linnæus' shell may have been a fossil one.

D. STENOSCHIZUM Pilsbry & Sharp, n. sp. Pl. 19, figs. 10, 11, 12, 13, 14, 15.

Shell rather strongly arcuate toward the smaller end, *rapidly tapering, the earlier portion slender* and delicate, the length about 10 times the diameter of aperture. *Milk-white*, somewhat translucent. *Very glossy* and polished throughout, and *entirely without sculpture* except for slight, inconspicuous annular irregularities of growth. Aperture slightly oblique, nearly circular, being a trifle compressed laterally; peristome thin. Anal orifice circular, with thin edges. *Slit extremely narrow, linear, and long*, its length contained about 3½ times in length of shell, situated on the convex side.

Length 35, antero-posterior diam. aperture 3·4, lat. diam. 3·2; diam. of apex 0·6 mill.

Length 34·5, antero-posterior diam. aperture 3·5, lat. diam. 3·4; diam. of apex 0·5 mill.

West Indies.

D. translucidum Desh., SOWERBY, Thes. Conch., iii, p. 98, pl. 225, f. 47 (1860); Conch. Icon., xviii, pl. 6, f. 39 (1872). Not *D. translucidum* Desh., 1825.

Distinguished by its rapidly tapering form, the smoothness of its glittering surface, with no trace of striæ even at the apex, and the long linear slit of a *Fustiaria*. *D. translucidum* Desh. is an unslit species and less attenuated toward the apex. Types in Coll. A. N. S. P., no. 71081.

Fig. 13 shows the actual length of the slit. Figs. 10, 11 are enlarged ventral and dorsal views of the apex. Fig. 15 is an old shell.

D. TENUIFISSUM Monterosato. Pl. 19, figs. 16, 17.

This form is much like *D. rubescens* except that there is a very long, linear slit on the convex side. We have followed Jeffreys in treating it as a variety of *D. rubescens* (see p. 106); but the form is more likely to prove a distinct species of *Fustiaria*.

Family SIPHONODENTALIIDÆ.

=*Siphonopoda* Sars, *Gadilinæ* Stoliczka, *Siphonodentaliinæ* Tryon, *Siphonodentaliidæ* or *Siphonopodidæ* Simroth.

Scaphopoda having the foot either expanded distally in a symmetrical disk with crenate continuous edge with or without a median finger-like projection, or simple and vermiform, without developed lateral processes. The shell is small and generally smooth, often contracted towards the mouth. Other characters essentially as in *Dentaliidæ*.

Distribution, all seas, almost exclusively in deep water.

The essential character of this family is in the structure of the foot. In the *Dentaliidæ* there is an "epipodial" sheath, which is *discontinuous or interrupted on the side toward the head*, and emarginate or deeply notched on the opposite side, being most expanded laterally; the foot itself projecting as a well developed conic mass beyond the sheath, and with the subtriangular lateral expansions of the latter, having a more or less trifid or fleur-de-lis appearance. In the *Siphonodentaliidæ* the "epipodium" forms *a continuous disk*, apparently terminal upon the foot in some forms, like a daisy on its stem; in others, with a small finger-like median process homologous with the large conic central body of the foot in *Dentalium*. In *Cadulus* (*Helonyx*) *clavatus* (Gld.), as figured by Stimpson, no epipodium of any sort is developed.

There cannot be much doubt that the shape of the epipodial disk is subject to considerable change during the process of burrowing, as its hollow or channelled structure is to some extent comparable with that of the foot of *Solen* and other digging Pelecypods; but so far as now known, there is no Siphonodentaloid form having the epipodium interrupted dorsally and the foot itself well developed beyond it, as in the *Dentaliidæ*.

We know of no family of like extent so imperfectly known anatomically as this one. With the exception of some excellent work by the Sars, father and son, a few descriptions by Jeffreys and others, and an outline drawing by *Stimpson*, no data have been published. What little is known of the soft parts indicates that important results may be expected from observations on a larger number of species, especially in the genus *Cadulus*. At present it is only possible to base the genera and subgenera upon characters of the shell. For further anatomical details see the introductory portion of this work, where the distribution of the species is also discussed.

There has been no monograph of *Siphonodentaliidæ* published, or, at least, none of any value; but a very large amount of information is contained in the works of M. and G. O. Sars, Jeffreys, Watson, Dall and Verrill. Dr. Simroth gives a very valuable general account of the group in the new edition of Bronn's Klassen und Ordnungen des Thier-Reichs, iii, 1895.

Key to genera of Siphonodentaliidæ.

I. Shell largest at aperture, thence tapering to apex.
  a. Longitudinally ribbed, angular in section at least near the apex, ENTALINA, p. 131.
  a'. Smooth; circular or subcircular in section throughout, SIPHONODENTALIUM, p. 135.
    b. Apex cut into lobes or teeth, Section *Siphonodentalium*.
    b'. Apex simple, unslit, Section *Pulsellum*.

II. Shell more or less swollen near the middle or anteriorly, contracting toward the aperture as well as tapering posteriorly, CADULUS, p. 142.
  a. Apex with slits or notches.
    b. Apex with two lateral slits, Section *Dischides*.
    b'. Apex with four or more slits, Section *Polyschides*.
  a'. Apex entire, unslit.
    b. Obese; both ventral and dorsal outlines convex and projecting beyond a chord connecting the adjacent lip edges, Section *Cadulus s. s.*
    b'. More slender or attenuated; ventral outline convex; dorsal outline as a whole concave, not projecting beyond a chord connecting the ends of shell. Section *Gadila*.

Genus ENTALINA Monterosato, 1872.

Entalina Monts., Notizie intorno alle Conchiglie Fossile di Monte Pellegrino e Ficarazzi, p. 27, for *D. quinquangulare* Forbes.—*Pulsellum* Stoliczka and *Siphonentalis* G. O. Sars, in part.—*Dentalium* sp. of some authors.

Shell *Dentalium*-like, largest at the aperture, thence tapering to the apex; strongly ribbed, and angular in section near the apex. Foot expanding distally into a disk with digitate periphery, and having a median process or filament. Type *E. quinquangularis* (Forbes).

With the shell of *Dentalium*, this group combines the form of foot of *Pulsellum*. It differs from all other *Siphonodentaliidæ* in the strong sculpture of the shell; and in a group otherwise so constantly characterized by smooth, rounded shells, this strongly angular exterior is apparently as important as anything. Even though *Cadulus*, *Siphonodentalium* and their satellite groups be merged into one genus, we would still segregate *Entalina*.

E. QUINQUANGULARIS (Forbes). Pl. 24, figs. 30, 33, 34, 35, 36, 37, 38.

Shell small, slender, evenly and considerably tapering from base to apex, the apical half strongly curved, larger half of the tube nearly straight. Very faintly buff tinted, bluish-white in places; lusterless. Sculpture: *at and near the apex five-sided and five-angled*, the angle along the incurved side obtuse, the others nearly right angles; spaces between the angles flat, gradually becoming convex as the tube enlarges, the angles at the same time becoming weaker and then obsolete, so that *the later third of the shell is cylindrical;* between the angles several cord-like riblets appear a short distance from the apex, and continue to the aperture, where they number about 28 or 30. Aperture quite oblique, circular in adult shells; apex minute, the orifice with simple edge or variously irregularly chipped or nicked by breakage. Length 12–13, diam. at aperture 1·5 mill.

Lofoten, Norway to Spain; Mediterranean, east to the Ægean, 5 to 650 fms.; *Pliocene of S. Italy and Sicily.*

Dentalium quinquangulare FORBES, Rep. Ægean Invert., in Rep. Brit. Asso. Adv. Science for 1843, p. 188 (1844).—SOWERBY, Thes. Conch., iii, p. 103, pl. 224, f. 33 (1860).—*Siphonodentalium quinquangulare* Forbes, JEFFREYS, Ann. Mag. Nat. Hist. (3), xx, p. 251 (1867); (Series 4), v, p. 442, and vi, p. 74 (1870).—WEINKAUFF, Conch. des Mittelm., ii, p. 421 (1868).—ARADAS & BENOIT, Conch. Viv. Mar. Sicil., p. 118 (1870).—LOCARD, Prodr. Mal. Fr., in Ann. Soc. d'Agricult. Lyon, (5), ix, 1886, p. 149.—DAUTZENBERG, Mem. Soc. Zool. France, iv, p. 609.—*Siphodentalium quinquangulare* Forbes, JEFFREYS, P. Z. S., 1882, p. 663.—*Siphonentalis quinquangularis* Jeffr. CARUS, Prodr. Faun. Medit., p. 176.—*Entalina quinquangulare* Forbes, MONTS., Nomencl. Gen. e Spec. Conch. Medit., p. 33 (1884).

Dentalium? (*Entalina*) *tetragonum* Brocc. Monterosato, Notiz. Conch. Foss M. Pellegr. e Ficarazzi, p. 27 (1872).—*Siphonentalis tetragona* G. O. Sars, Moll. Reg. Arct. Norv., p. 105, pl. 20, f. 13 *a-c*, shell; and pl. I, f. 4, dentition (1878).—*Siphodentalium tetragonum* Brocchi, Jeffreys, Ann. Mag. N. H. (5), vi, p. 317 (1880). —*Entalina tetragona* Brocc., Monts., Bull. Soc. Malac. Ital., vi, p. 64 (1880). Not *Dentalium tetragonum* Brocchi.

"*Dentalium dentalis* or *quadrangulare*" MacAndrew, Rep. Brit. Asso. Adv. Sci. for 1850, p. 267 (1851).

Dentalium abyssorum, juv., M. Sars, Om de i Norge forekommende fossile Dyrelevninger fra Qvartærperioden, University Programme for 1864, p. 43, f. 107–109.

Siphonodentalium pentagonum M. Sars, Forh. Vidensk.-Selskabet i Christiania, for 1864, p. 307, pl. 7, f. 45–51 (1865).

The strongly pentagonal posterior part of the shell, with rather coarse riblets between the angles, and an oblique, circular aperture, readily distinguish this from any *Dentalium*.

The soft parts, as figured by M. Sars (see pl. 14, figs. 30, 37, 38) have the characters of *Siphonodentalium*. The very young have a bulbous, pear-shaped nucleus, as in *Dentalium*. Jeffreys states that "the terminal notches, usually one on each side, agree with those in most species of *Siphodentalium*. Some Norwegian specimens have five notches, and are jagged like *S. vitreum*." The specimens we have seen are either even-edged or irregularly jagged at the apex.

We have compared specimens of *E. platamodes* Watson, and consider it sufficiently distinct.

E. platamodes (Watson). Pl. 23, figs. 3, 4, 5.

Shell small, solid, finely tapered, curved, especially toward the apex, five-sided, with four sharp corners, which are nearly right angles, and one very obtuse angle along the concave curve; these all tend to disappear toward the apex, the young shell being rounded. Sculpture: the angles of the shell project more or less in a sharp rounded rib, which is sometimes double; there are a few longitudinal striæ, regular, 0·01 inch apart, strongest near the angles, more or less obsolete as they recede from these. Neither end is fresh enough for description. Length 0·47 inch, breadth 0·049 inch. (*Watson*).

North of Culebra Island, West Indies, lat. 18° 38′ 30″ N., long. 65° 5′ 30″ w., 390 fms. (Challenger); *Florida Strait, 33½ miles S. of*

Rebecca Shoal, lat. 24° 02′, long. 82° 31′ 30″ in 430 fms. (Wm. H. Rush).

Siphodentalium platamodes Wats., Journ. Linn. Soc. Lond., xiv, p. 519 (1879); Chall. Rep. Scaph. and Gastr., p. 13, pl. 2, f. 4.—*Dentalium platamodes* Dall, Bull. U. S. Nat. Mus., no. 37, p. 76 (1889).

I have hesitated a good deal in separating this from *Siphodentalium tetragonum* Broc.=*quinquangulare* E. For., with which it agrees more closely than with *Siphodentalium pentagonum* Sars. Here, however, the longitudinal ribs are much closer, as well as much more obsolete; the shell is more curved throughout its whole length, is more attenuated, and retains its square form and sharp angles instead of becoming rounded as in *S. tetragonum* Brocchi. Amidst all the variations of that very variable form I have not seen any that connect it with this species (*Watson*). It may be added that the specimens dredged by Dr. Rush confirm the distinctions between this species and the preceding.

E. mirifica (Smith). Pl. 20, fig. 29.

Shell small, strongly curved and acuminate toward the apex, quadrate tubular, wider along the inner curve than along the outer; longitudinally delicately striate, very delicately sculptured with growth-lines; subconcave between the angles. Length 19, greatest diam. 2½ mill. (*Smith*).

Off Trincomalee, Ceylon, 200–350 fms.

Dentalium mirificum E. A. Smith, Ann. Mag. Nat. Hist. (6), xvi, p. 9, pl. 2, f. 1 (July, 1895).

This little species is remarkable for the sharply curved end and the subquadrate form. The four angles are acute at the tip, but gradually become obtuse as the shell increases. The incurved side is the broadest of all, and up the middle of it, especially towards the apex, there is a raised striation more conspicuous than the rest. This is so prominent at the end that, when viewed with the opening towards the eye, five angles are visible. The two angles on the excurved side, which is the narrowest of all, become almost obsolete near the aperture. The form of the aperture, owing to the greater width and flatness of the incurved side, is very like the letter D.

Siphodentalium quinquangulare Forbes is a much more slender species, and more circular in section near the aperture.

I have placed this species temporarily in *Dentalium*, as the tips of the four specimens examined are all damaged. Possibly more perfect examples may exhibit slits as in *Siphodentalium* (*Smith*).

The single specimen we have seen (in Coll. U. S. Nat. Mus.) is so similar to *E. quinquangularis* that we adopt Mr. Smith's suggestion that it may belong near that species. The apical slitting is a variable character, and rarely developed in *Entalina*.

Genus SIPHONODENTALIUM M. Sars, 1859.

Siphonodentalium M. Sars, Forh. Videnskabs-Selskabet i Christiania, Aar 1858, p. 52 (1859). Om *Siphonodentalium vitreum*, etc., Univ. Programme for 1861.—G. O. Sars, Moll. Reg. Arct. Norv., p. 103, restricted to *S. vitreum*.

Siphodentalium Monterosato, Journ. de Conchyl., 1874, p. 258, and in subsequent papers.—Jeffreys, Ann. Mag. Nat. Hist. (4), xix, p. 155 (1877), and in later papers.—Watson, Challenger Report on Scaphopoda (1886).

Siphonodontum or *Tubidentalium* Locard, Prodr. Mal. Fr. in Ann. Soc. d'Agricult. Lyon, 1886, p. 149, footnote; emendations of *Siphonodentalium*.

Shell an arcuate, slightly tapering tube, largest at the aperture, circular or nearly so in section, and smooth externally. Apex rather large, typically slit into lobes, but sometimes simple. Foot capable of expanding into a terminal disk. Type *S. lobatum*.

A widely distributed genus of few species, confined to deep water except in high latitudes.

G. O. Sars divides *Siphonodentalium* into two groups: *Siphonodentalium* (restricted), in which the apex of the shell is cut into lobes (pl. 23, fig. 12), and the terminal pedal disk is concave in the middle, without a central process (pl. 23, figs. 9, 18).

Siphonentalis Sars, having the apex of the shell entire (pl. 24, fig. 42), and the terminal disk of the foot convex in the middle, with a long central process (pl. 24, fig. 40).

This division is based upon too few species to warrant the adoption of two genera; the more as we have found the development of slits to be a feature of minor importance in other groups of *Scaphopoda*.

Key to Species of Siphonodentalium.

I. Apex with slits.

a. Slowly tapering; apex 6-lobed; length 10 mill., *lobatum*.

a'. Rapidly tapering; apex with at least two slits; length 5·5 mill., *tytthum.*

a''. Apex 2-slit, the clefts dorsal and ventral; length 8–9 mill., *teres.*

II. Apex simple, unslit.

a. Atlantic and Mediterranean species.

b. White, but slightly pellucid; aperture 3 times as wide as apex; length 6 mill or less, *lofotense.*

b'. Very pellucid, smooth; aperture twice the width of apex; length 4·5 mill., *affine.*

b''. Transparent, obliquely banded with opaque white; sharply scratched with minute transverse striæ; length 3 mill., *pusillum.*

a.' From Torres Strait. Very gradually tapering, translucent and transparent in alternate bands; excessively minute longitudinal striæ; length about 3·5 mill., *eboracense.*

Section SIPHONODENTALIUM (restricted).

S. LOBATUM (Sowerby). Pl. 23, figs. 8 to 21.

Shell cylindric, very smooth and glossy, thin, pellucid, glassy; arcuate; slowly tapering from the aperture to a rather large apex, which is cut into six lobes or teeth: a subtriangular one on each side, two contiguous lobes on the convex side (figs. 14, 19), and two very short lobes on the concave side (fig. 13). Aperture circular, oblique. Length 10 mill.

Arctic Ocean from Spitzbergen and Novaia Zemblia to Finmark (Sars and others); *North Atlantic between Faroes and Orkney Is.*, 560 fms.; *off coast of Portugal*, 740–1095 fms. (Lightning and Porcupine Expeditions); *Gulf of St. Lawrence*, 150–200 fms. (Whiteaves); *Gulf of Maine and off Martha's Vineyard* (U. S. Fish Commission).

Dentalium vitreum M. SARS, Nyt Mag. f. Naturvidenskaberne, vi, p. 178 (1851). Not *Dentalium vitreum* Gmel. Syst. Nat. (13), p. 4739.

Siphonodentalium vitreum M. SARS, Forh. Videnskabs-Selskabet i Christ., Aar 1858, p. 52 (1859); Om *Siph. vit.*, en ny Slægt og Art af Dentalidernes Familie, Universitets-Program for første Halvaar, 1861, pp. 29, pl. 1–3 (except figs. 78–81); Om de i Norge Forekommende Fossile Dyrelevninger fra Qvartærperioden, Univ. Progr., for 1864, p. 42, pl. 3, f. 99 (1865).—G. O. SARS, Moll. Reg. Arct.

Norv., p. 103, pl. 7, f. 2 *a-c*, and pl. I, f. 2 (radula).—VERRILL, Trans. Conn. Acad. Sci., v, p. 557, pl. 42, f. 19; Proc. U. S. Nat. Mus., iii, p. 394.

Siphodentalium vitreum M. SARS, JEFFREYS, Ann. Mag. Nat. Hist. (4), xix, p. 155 (1877); P. Z. S., 1882, p. 662.

Dentalium lobatum G. B. SOWERBY, JR., Thes. Conch., iii, p. 100, f. 44 (1860); Conch. Icon., xviii, pl. 5, f. 36 (1872).—CLESSIN, Conchyl. Cab., p. 15, pl. 4, f. 6 (1896).—"*D. labiatum* Sow." in Zoological Record for 1877, Moll., p. 79.

The well-known name *vitreum* being preoccupied, we have been compelled to substitute *lobatum* Sowerby, which applies to exactly the same form, as Jeffreys and others have recognized.

Jeffreys describes the soft parts as follows: "Body whitish, gelatinous, and nearly transparent; *mantle* rather thick, forming a collar round the foot; *tentacles* thread-like, very slender, and having oblong tips or bulbs; they are not numerous, but extensile and irregular in length, issuing from underneath the edge of the mantle: *foot* cylindrical, extensile, and attaining a length equal to that of the shell; when at rest it is conical; but the point fully stretched out expands into a round and somewhat concave disk with serrated or notched edges; *excretal fold* or tail at the narrowest end of the shell, tubular, and having the front split open and exposed diagonally; edges jagged; externally covered with very fine and close set cilia; *liver* dark-brown; *ovary* lemon color."

S. TYTTHUM Watson. Pl. 23, fig. 2.

Shell minute, very conical, *i. e.*, broadening rapidly, much bent, very thin, but not hyaline, apparently horny when living, and becoming opaque when dead, and then also glossy but not brilliant. Sculpture: some very faint traces of circular striæ on the lines of growth. Mouth-edge very thin and chipped. Apex broken, but in one specimen showing the two lateral clefts common in the genus.

Length 0·22 inch., breadth at mouth 0·049; at apex 0·013 inch. (*Watson*).

North of Culebra Island, West Indies, 390 fms. (Challenger).

Siphodentalium tytthum WATS., Journ. Linn. Soc., xiv, p. 520 (1879); Chall. Rep., p. 14, pl. 2, f. 5.

In texture and general form this is like *S. vitreum* Sars, but it broadens much faster and is more curved. (*Watson*).

There is apparently no contraction toward the aperture.

Group of S. teres.

S. TERES Jeffreys. Pl. 26, fig. 72.

Shell cylindrical, gradually tapering to the basal point or posterior extremity, gently curved, thin, glossy, and semitransparent. Sculpture, none except fine and numerous lines of growth; color whitish; mouth circular; apex slightly but distinctly notched above and below. Length 0·35, breadth 0·05 inch. (*Jeffreys*).

North Atlantic, ('Porcupine' Stations 16, 17, 17*a*).

Siphodentalium teres JEFFR., P. Z. S., 1882, p. 661, pl. 49, f. 5.

The position of the terminal notches in this species differs from that of the slits in *Dischides*, being placed one on the convex and the other on the concave end of the shell in *S. teres*, instead of being bilateral as in that shell. (*Jeffreys*).

Section PULSELLUM Stoliczka, 1868.

Pulsellum STOL., Cret. Fauna of S. India, ii, p. 441, for *S. lofotense*, *affine* and *pentagonum*=*quinquangulare*.—FISCHER, Manuel de Conchyl., p. 894.

Siphonentalis G. O. SARS, Moll. Reg. Arct. Norv., p. 104 (1878), for *S. lofotensis*, *S. affinis* and *S. tetragona*=*quinquangulare*.

Siphonodentalis [sic] CLESSIN, in Systemat. Conchylien-Cabinet, vi, Heft xi, 424te Lieferung, p. 30 (1896).

Similar to *Siphonodentalium* except that the shell has no apical slits and the foot-disk bears a terminal filament. Type *S. lofotense* Sars.

The name *Pulsellum* was proposed for the same three species upon which *Siphonentalis* was founded a decade later. Meantime, Monterosato had removed *S. quinquangulare* to his new genus *Entalina*, leaving *S. lofotense* and *affine* to bear the earlier name. The additional species now placed here are of uncertain affinities; and the posterior simplicity may in some cases be the result of loss of teeth by breakage, which is frequent enough in *Siphonodentaliidæ* with lobed apices to pretty thoroughly vitiate any attempt to draw hard and fast lines using the slits as a basis.

S. LOFOTENSE M. Sars. Pl. 24, figs. 40, 41, 42, 43, 44.

Shell rather solid, white, but little pellucid, cylindrical, smooth; growth-striæ somewhat oblique, moderately conspicuous; form narrowly subarcuate, moderately attenuated toward the apex. Aper-

ture nearly three times the width of apical orifice. Length as much as 6 mill. (*G. O. Sars*).

Lofoten Is. and other places from Christiania fjord to Haswig in Finmark, 30–300 fms. (Sars and others); *Hebrides and Shetland*, 40–140 fms. (Jeffreys); *Clyde district and Lismore* (Chaster and Heathcote); *West of Ireland* in 90–1630 fms.; *Bay of Biscay*, 227–1095 fms.; *Vigo Bay*, 20 fms. (Porcupine Exped.); *Gulf of Gascony*, 60–80 fms. (Folin); *Mediterranean and Ægean Seas*, 50–1456 fms. (Porcupine, Acton, Spratt, Monts.); *Off New England*, 500 fms. (Verrill); *Pliocene of Calabria and Sicily*.

Siphonodentalium lofotense M. Sars, Forh. Vid. Selsk. Christiania, 1864, p. 29, pl. 6, f. 29–33 (1865).—Jeffreys, Nature, i, p. 135; Ann. Mag. Nat. Hist. (3), xx, p. 250 (1867); (4), ii, pp. 299, 301 (1868); v, p. 442 (1870); vi, p. 74 (1870); Brit. Conch., v, 195, pl. 101, f. 2; Proc. Roy. Soc. Lond., xxv, p. 199.

Siphodentalium lofotense Sars, Jeffreys, Ann. Mag. N. H. (4), xix, p. 156 (1877); (5), vi, p. 317 (1880); xi, p. 395 (1883); P. Z. S., 1882, p. 662.—*Siphonodentalium lofotensis* Sars, Aradas & Benoit, Conch. Viv. Mar. Sicilia, p. 118 (1870).—*Siphonentalis lofotensis* M. Sars, G. O. Sars, Moll. Reg. Arct. Norv., p. 104, pl. 20, f. 11*a-b*; pl. I, f. 3, (1878).—Verrill, Proc. U. S. Nat. Mus., iii, p. 395; Amer. Journ. Sci., xx, 1880, p. 392; Trans. Conn. Acad. Sci., v, p. 558.—*Pulsellum lofotense* Sars, Chaster & Heathcote, Journ. of Conch., vii, p. 304.

Specimens from the Bay of Biscay and the Mediterranean are usually much smaller than those from more northern seas. (*Jeffreys*).

Jeffreys remarks: "The shell may easily be passed (as it was by me) for the young *Dentalium entalis;* but it is more curved and cylindrical, the mouth and corresponding lines of growth slope backwards, and the margin of the posterior orifice is regularly jagged (having two slight notches on each side), and this extremity does not form a bulbous point in the fry. One of the characters given by Sars ("margine aperturæ posterioris integro") should be amended. My observation of the animal agreed with his, except that the foot is vermiform and has a fine point, the disk being expanded and assuming the shape of a flower only when the Siphonodentalium wishes to obtain a fulcrum and keep its place in the sand. The foot of Nucula and Leda is somewhat similar, its disk when expanded resembling the leaf of a palm."

S. AFFINE M. Sars. Pl. 24, figs. 45, 46, 47.

Shell thin, very pellucid, shining, very smooth, the growth striæ but slightly visible; cylindric, slightly subarcuate, a little tapering toward the apex; aperture about twice the width of the apex, which is circular with entire margin. Length 4½ mill. (*G. O. Sars*).

Finmark and Lofoten Is., 100–300 fms. (Sars); *West of Ireland*, 1215–1380 fms., *and Channel slope*, 690 fms. (Porcupine); *Bedford Basin, near Halifax, Nova Scotia*, in 35 fms. (Verrill).

Siphonodentalium affine M. SARS, Forh. Videns. Selskabet Christiania for 1864, p. 300, pl. 6, f. 34, 35 (1865).—*Siphodentalium affine* M. Sars, JEFFREYS, Ann. Mag. N. H. (4), xix, p. 156 (1877); P. Z. S., 1882, p. 661.—*Siphonentalis affinis* M. Sars, G. O. SARS, Moll. Reg. Arct. Norv., p. 104, pl. 20, f. 12 (1878).—VERRILL, Proc. U. S. Nat. Mus., iii, p. 395; Trans. Conn. Acad., v, p. 558, pl. 42, f. 20*a*, *b*.

Not the young of *S. vitreum* [*lobatum*], which in all stages of growth is more conical and not so cylindrical as *S. affine;* and the point is also different. The present species is not half the size of *S. teres*, and is much less slender and tapering. (*Jeffreys*).

S. PUSILLUM Watson. Pl. 23, fig. 6.

Shell minute, attenuated, slightly bent, thin, transparent, irregularly banded with opaque white, which runs elliptically round the shell. Sculpture: there is no trace of longitudinal striæ, but the whole surface is sharply scratched with minute transverse striæ, which run (as usual) not directly round the shell, but advance on the concave and retreat on the convex curve. Length 0·12 inch., breadth at small end 0·01; at broad end 0·02. (*Watson*).

Palma, Canaries, 1125 fms. (Challenger).

Siphodentalium pusillum WATS., Journ. Linn. Soc. Lond., xiv, p. 520 (1879); Chall. Rep., p. 14, pl. 2, f. 6.

The specimens are young, and both ends are chipped. It is straighter and more tumid than *Dentalium filum* Sow. (in part),= *Dentalium gracile* Jeffr., but more curved and broader than the young of *D. capillosum* Jeffr. It is much larger, more tumid, and straighter for the same length than *Siphodentalium lofotense* Sars. (*Watson*).

S. EBORACENSE Watson. Pl. 26, fig. 75.

Shell small, narrow, tapering very gradually throughout, toward the apex bent, thin, brilliant, translucent, and transparent in alter-

nate bands. Sculpture: there are a few remote, irregular oblique, transverse striæ; in the young shell the whole surface is covered with longitudinal striæ, excessively minute (0·0005 in. apart), sharp and regular, but which seem very easily rubbed off (on two specimens they are barely traceable), and which disappear towards the mouth. The mouth is round, very oblique, sharp, and thin. The apex is minute, and is broken straight across, and somewhat chipped. Length 0·185 inch., breadth 0·024; at apex, 0·008 inch. (*Watson*).

Torres Strait, Cape York, N. E. Australia, 3–11 fms. (Challenger).

Siphodentalium eboracense Wats., Journ. Linn. Soc. Lond., xiv, p. 523 (1879); Chall. Rep., p. 17, pl. 2, f. 10.

Than *Siphodentalium prionotum* Wats., this is smaller, straighter, but toward the apex more bent, not narrowed at the mouth; smaller at the apex, and the whole texture of the shell is different. Than *Siphodentalium vitreum* Sars, this is less cylindrical, is not contracted toward the mouth, and is much smaller toward the apex. (*Watson*).

Siphonodentalium (?) n. sp. Pl. 28. figs. 6, 7, 8, 9.

A species of *Siphonodentalium*, or an immature *Cadulus* allied to *C. dalli*, is represented in the Jeffreys collection, U. S. Nat. Mus., by two individuals, the smaller of which is figured on pl. 28, figs. 6, 7, lateral and convex aspects, figs. 8, 9 representing the larger shell. The surface is smoothish and polished, with perceptible growth-striæ; hyaline, with some obliquely encircling white lines; section subcircular, a mere trifle compressed vertically. Apex with two lobes or teeth on the convex side, but apparently broken along the line of growth on the concave side from one lateral slit to the other, so that the number of teeth upon this margin is unknown; both specimens being alike in this particular.

Length 3·3, mill.; diam. at aperture 0·6 x 0·64, at apex 0·26 mill. (figs. 6, 7).

Length 4·4 mill.; diam. at aperture 0·6 x 0·62, at apex 0·26 x 0·28 mill. (apical teeth broken; figs. 8, 9).

Korea, in 54 fms. (St. John). U. S. Nat. Mus., no. 107705.

The material is too imperfect for generic determination, although taking locality into consideration, the specific form should be recognized from the above details when again encountered.

Genus CADULUS Philippi, 1844.

Includes *Cadulus* Phil., *Gadila* Gray, *Gadus* auct., *Helonyx* Stimp., *Dischides* Jeffr., *Loxoporus* Jeffr., *Polyschides* P. & S.

Tubular, circular or oval in section; somewhat arcuate; varying from cask-shaped to acicular; more or less bulging or swollen near the middle or above, contracting toward the aperture. Surface smooth or delicately striated.

The genus *Cadulus*, as we use that term, contains species of a great variety of shapes, and with various apical modifications, but having in common an inflated bulging shell which contracts more or less in caliber near the aperture as well as posteriorly. It is this anterior constriction which separates *Cadulus* from *Siphonodentalium*.

In some species of all the sections of the genus, a circular rib is developed within the apical orifice, while others lack it. This structure is not, therefore, characteristic of the typical division only, as some authors have claimed.

The subdivision of *Cadulus* by conchological characters (and there are as yet no adequate data upon the soft anatomy), is attended with difficulties; but as the size of the genus and the heterogeneous nature of its contents render some subdivision a convenience, the following scheme is offered.

The recognition of *Gadila* is an expedient of doubtful utility, for there are no very definite features separating it from the typical forms of *Cadulus*. The other sections are probably natural groups, although when the teeth are broken off, not an unusual accident, their differential characters are no longer apparent. It is hardly necessary to warn the investigator against this pitfall; but we may perhaps be allowed to beg indulgence lest we may not in every case have avoided it ourselves.

Key to sections of Cadulus.

I. Apex with slits or notches.
   a. Apex with two lateral slits only, Section *Dischides*, p. 143.
   a'. Apex with four or more slits, Section *Polyschides*, p. 146.

II. Apex entire, unslit.
   a. Obese; both ventral and dorsal outlines convex and projecting beyond a chord connecting the adjacent lip edges, Section *Cadulus s. s.*, p. .

a'. More slender or attenuated; ventral outline convex; dorsal outline as a whole concave, not projecting beyond a chord connecting the ends of shell, Section *Gadila*, p. .

Section DISCHIDES Jeffreys, 1867.

Dischides JEFFR., Annals and Magazine of Nat. Hist. (3), xx, p. 251 (in text).

Gadus "Rang," DESHAYES, Descr. Anim. s. Vert. Bassin de Paris, ii, p. 217, 1864, (in part) for *G. parisiensis* [= *C. denticulatus* Dh.], *G. bilabiatus* [= *C. bifissuratus* Dh.], and *G. brevis* Dh.

Shell rather slender, not much bulging; apex cut into an anterior and a posterior lobe by two deep lateral slits, one on each side. Type *C.* (*Dischides*) *politus* S. V. Wood.

Distribution: Recent in both the Atlantic and Pacific; Paris Basin Eocene to Pliocene of Europe.

Jeffreys describes the soft parts of *C. politus* as follows:

Body whitish, gelatinous; mantle rather thick, forming a collar round the front opening of the shell; *captacula* issuing from within the mantle, numerous, capable of so great an extension as to exceed the shell in length; stalks very slender; terminal bulbs oval; *foot* cylindrical and narrow, protruded from the middle of the mouth as from a sheath; it is occasionally thrust out in a darting manner and suddenly withdrawn, and so swiftly that the point of the foot could not be observed; the foot is usually curved towards the point; *anal tube* protruded beyond the narrower end or extremity of the shell; it consists of an outer and inner part, the latter being folded to suit the slit on each side; gills rather short, of a brownish color.

Key to species of Dischides.

I. Slender, but little contracted anteriorly, the length of shell 8 or 9 times its greatest diameter.

a. Slits at apex narrow and deep; tube contracting quite noticeably and suddenly near aperture; length 7·6 mill., about 9½ times the greatest diam., *politus*.

a'. Slits wide and triangular; tube very little contracted toward the aperture; length 9·2 mill., about 8½ times the greatest diam., *belcheri*.

a''. A shallow, rounded hollow on each side of apex; tube gently contracted at mouth; length 8·2 mill., about 8½ times the greatest diam., *prionotus*.

II. Considerably contracted anteriorly; slits deep and narrow; length 9 mill., about 6½ times the greatest diam., *dichelus.*

C. POLITUS (Searles Wood). Pl. 27, figs. 90, 91, 92, 93, 94.

Shell small and slender, thin, arcuate, considerably tapering; translucent bluish-white, with many unequal obliquely transverse lines and bands of opaque-white. Sculpture of fine, inconspicuous growth-striæ, running obliquely around the tube. Near the aperture the tube contracts quite noticeably. Aperture oblique, round-oval, a trifle wider than long; peristome thin and simple. Apex bilabiate, narrowly and deeply slit on each side, edges of the apical lobes bevelled.

Length 7·6, greatest diam. antero-posteriorly 0·81, laterally 0·81 mill.; aperture, greatest diam. 0·67, least 0·63 mill.; diam. at apex 0·31 mill.

Mediterranean, from Sicily to Gibraltar. Atlantic: Morocco; Canaries; Portugal at Setubal Bay; Gulf of Gascony; Benzert Road, Adventure Bank. Pliocene, Coralline Crag, England; Italy.

Ditrupa polita S. V. WOOD, Ann. Mag. Nat. Hist., ix, p. 459, pl. 5, f. 14 (August, 1842).

?? *Dentalium pusillum* PHIL., Enum. Moll. Sicil., i, p. 245 (1836), ii, p. 206 (1844).

Dentalium coarctatum PHIL., Enum. Moll. Sicil., ii, p. 208 (1844), not of Lam.

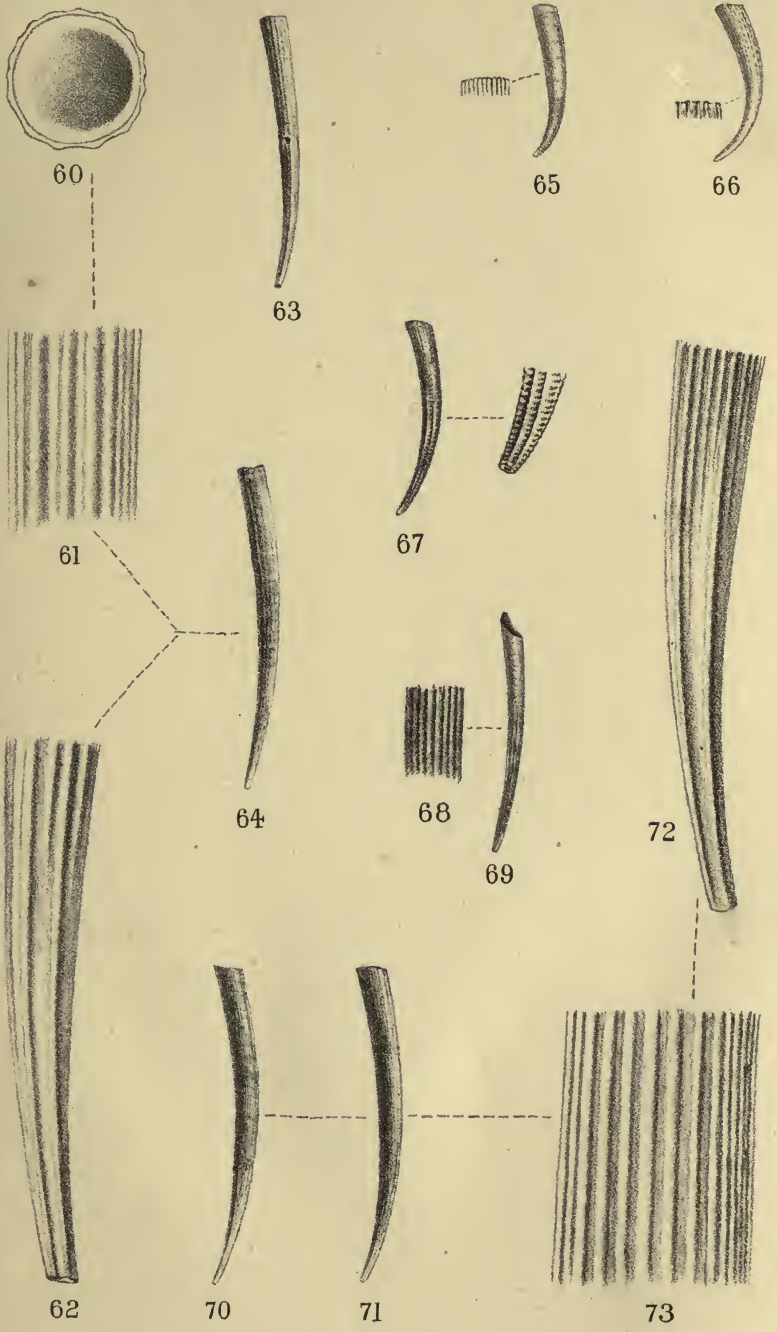
Dentalium lævigatum DE RAYNEVAL, v. d. HECKE & PONZI, Catal. foss. du Mont Mario, Versailles, 1854 (not seen by us). Not *D. lævigatum* Schlotheim, 1830.

Dentalium bifissum S. V. WOOD, Crag Moll., i, p. 190, pl. 20, f. 3, *a-b* (1848).

Dischides bifissum [*us*] Wood, JEFFREYS, Ann. Mag. N. H. (3), xx, p. 251 (1867); P. Z. S., 1882, p. 663.—ARAD. & BEN., Conch. Mar. Sicil., p. 117 (1870).—WEINKAUFF, Conch. des Mittelm., ii, p. 421 (1868).—MONTS., Nom. Gen. e Spec. Conch. Med., p. 34 (1884).

Dischides olivi Sc., JEFFREYS, Ann. Mag. Nat. Hist. (4), vi, July, 1870, p. 73.

The anterior contraction is much more abrupt than in *Dischides belcheri* or *D. brevis*. *C. bifissuratus* is a stouter, larger shell. The present species was first well defined as *Ditupa polita*, but this name has since been forgotten, and *olivi*, *coarctatum* and *bifissum* have been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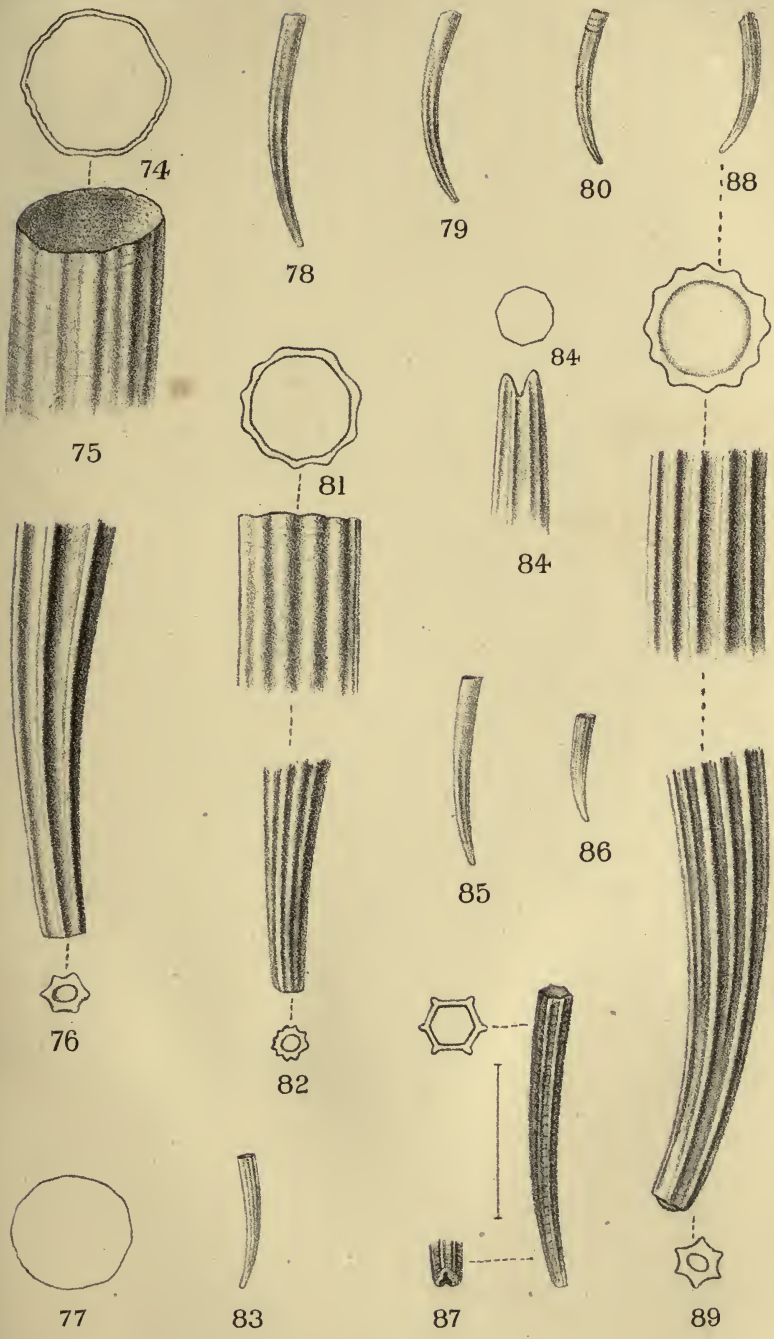
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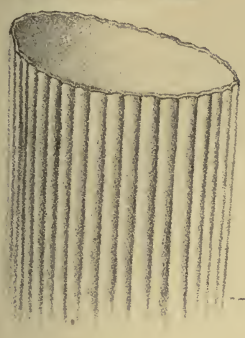

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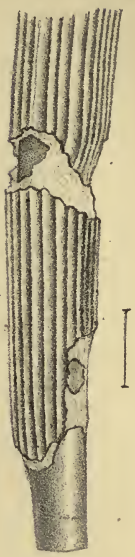

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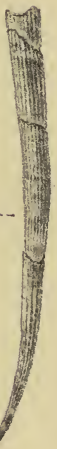

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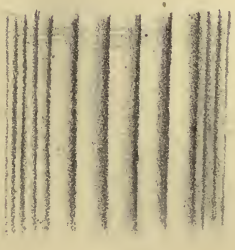

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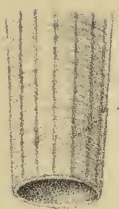

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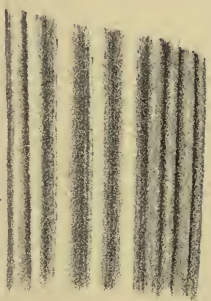

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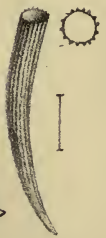

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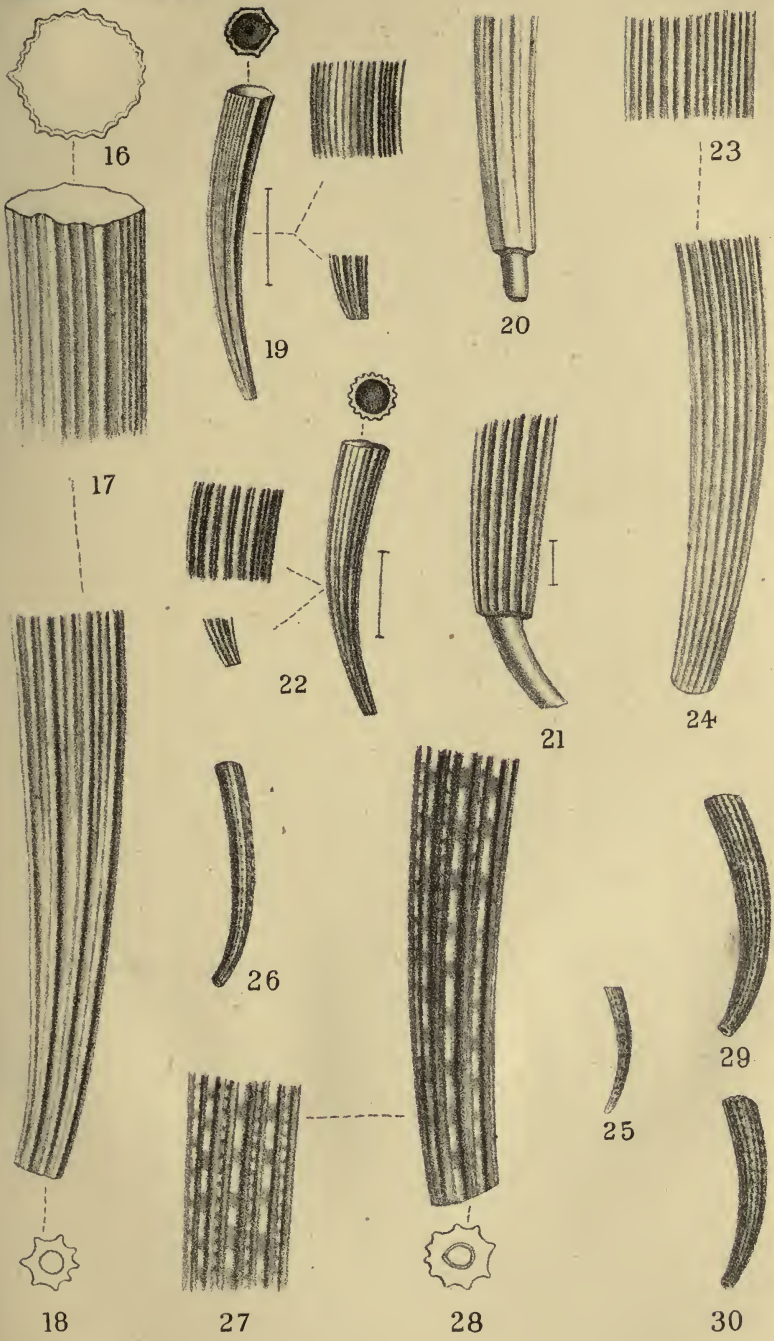
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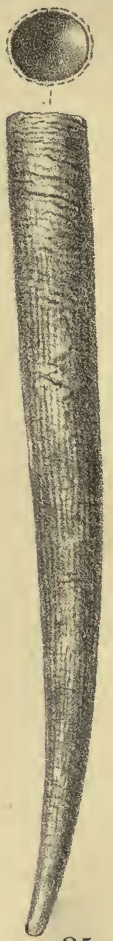

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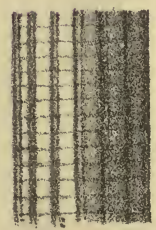

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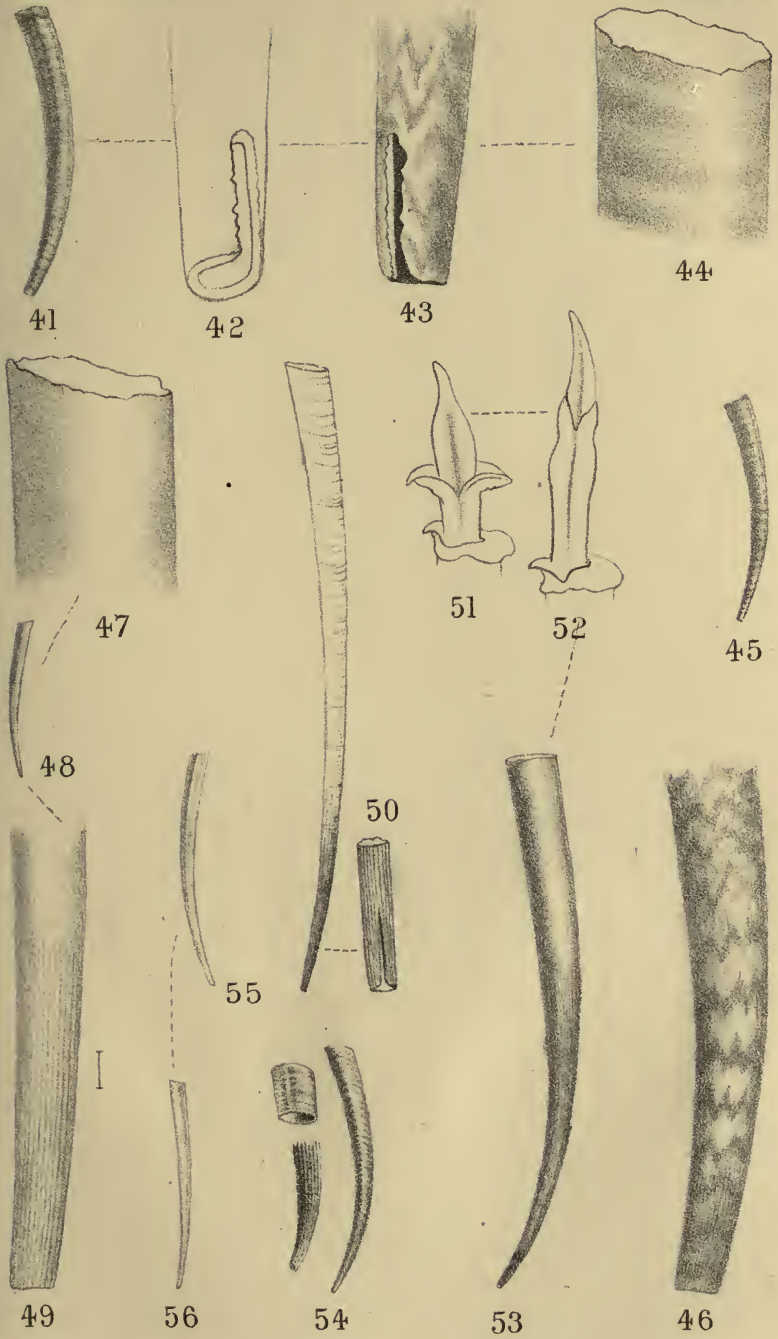
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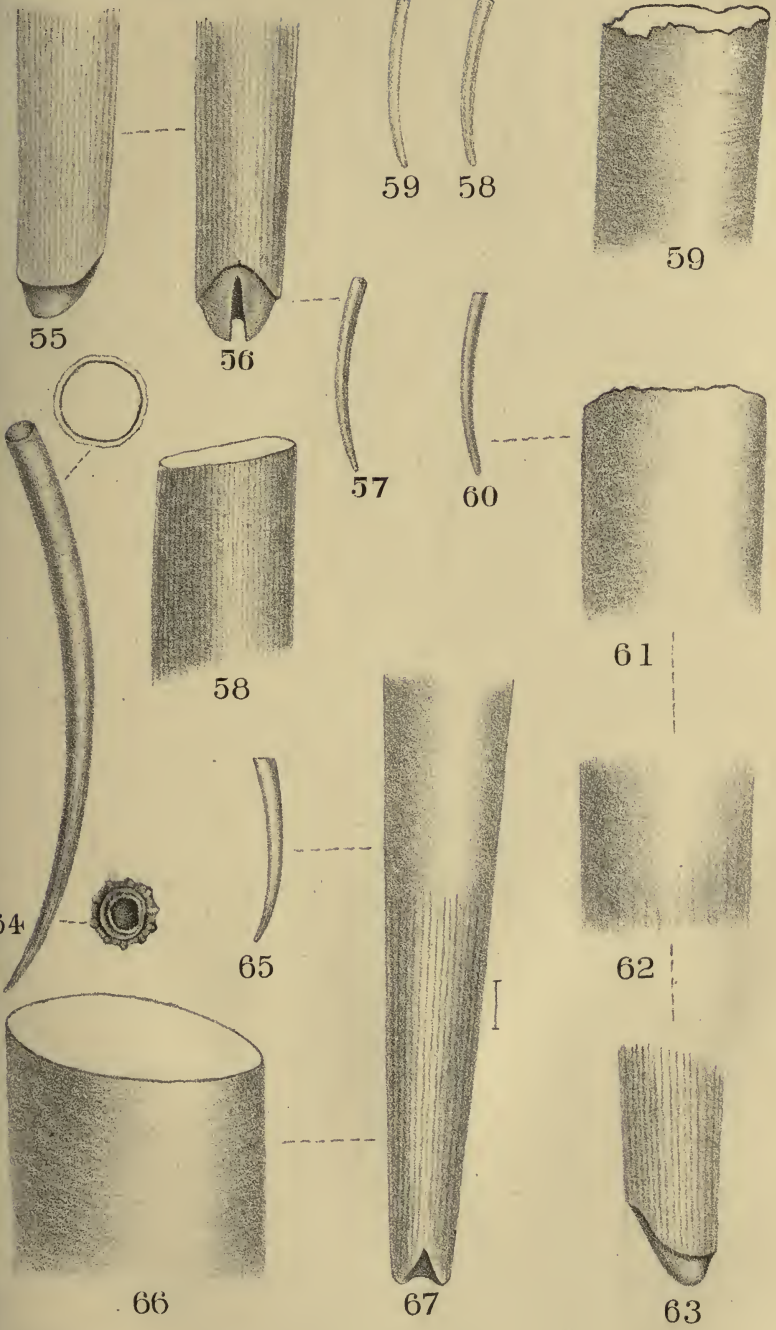
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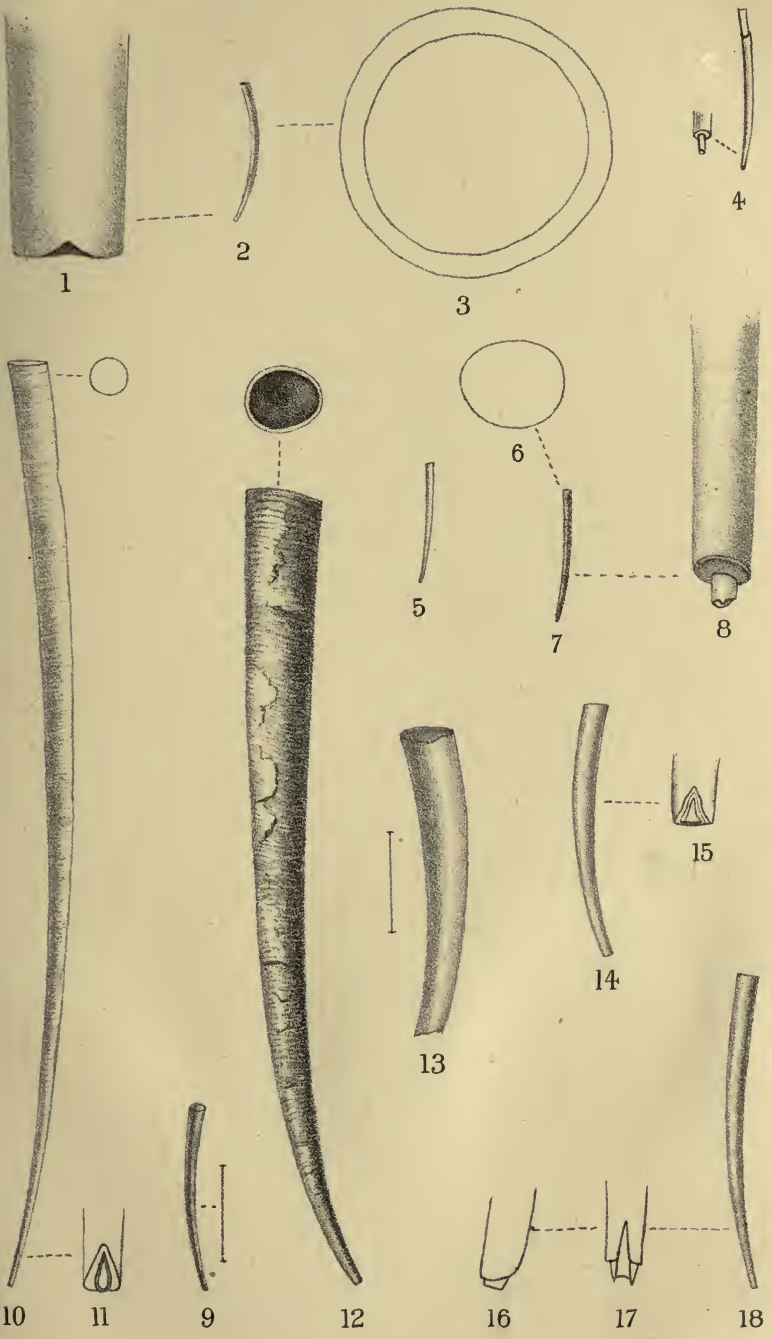
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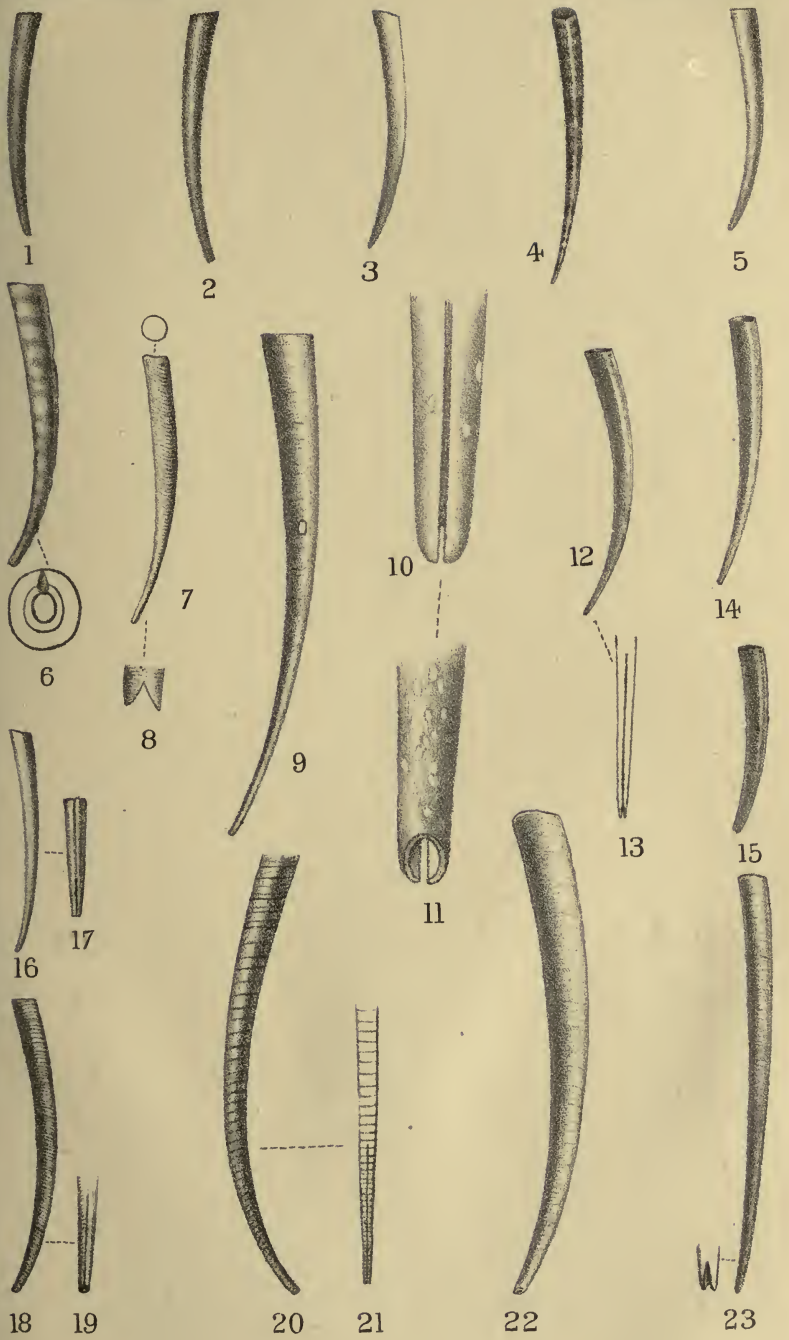
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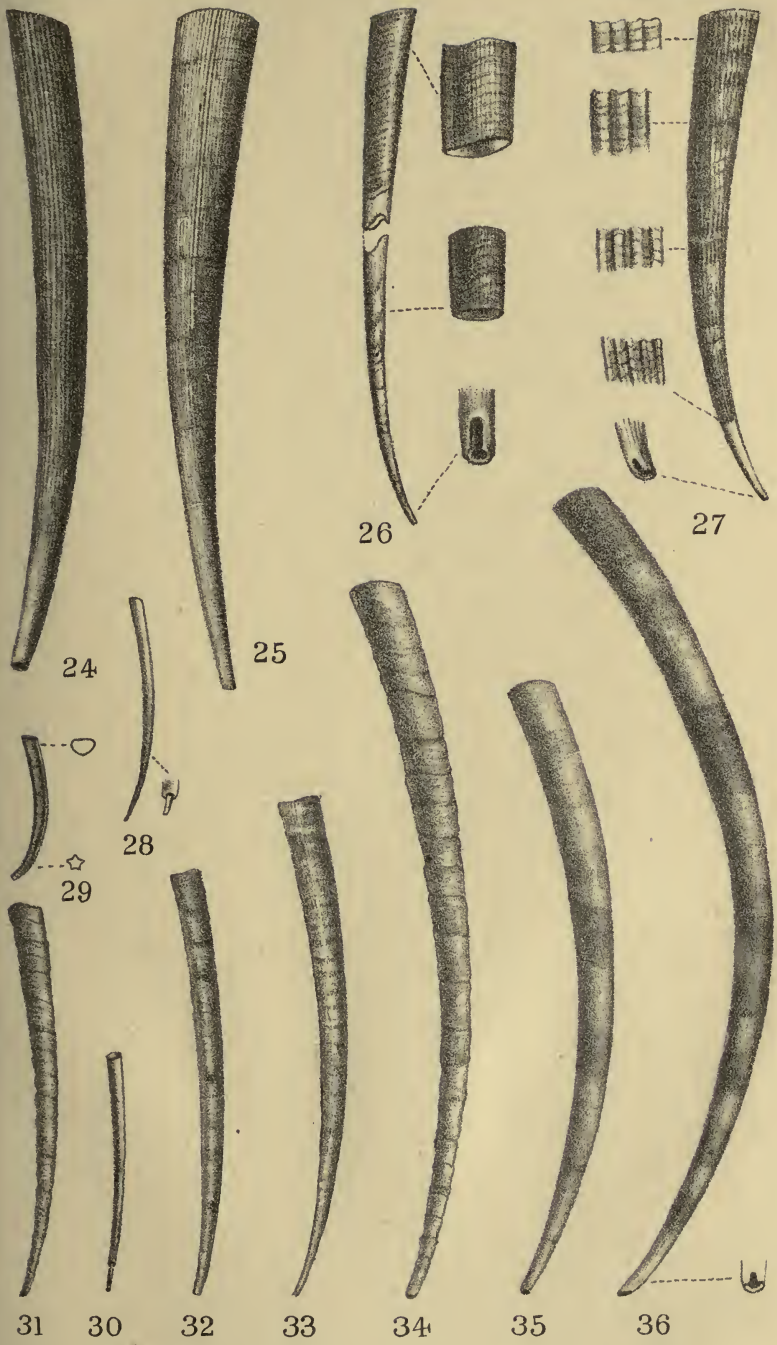
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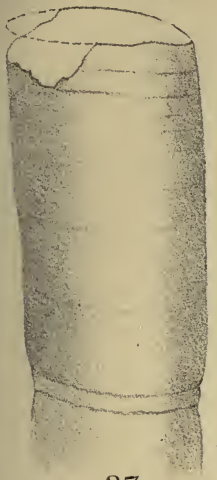

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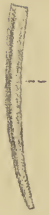

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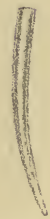

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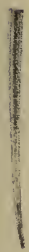

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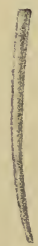

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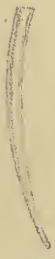

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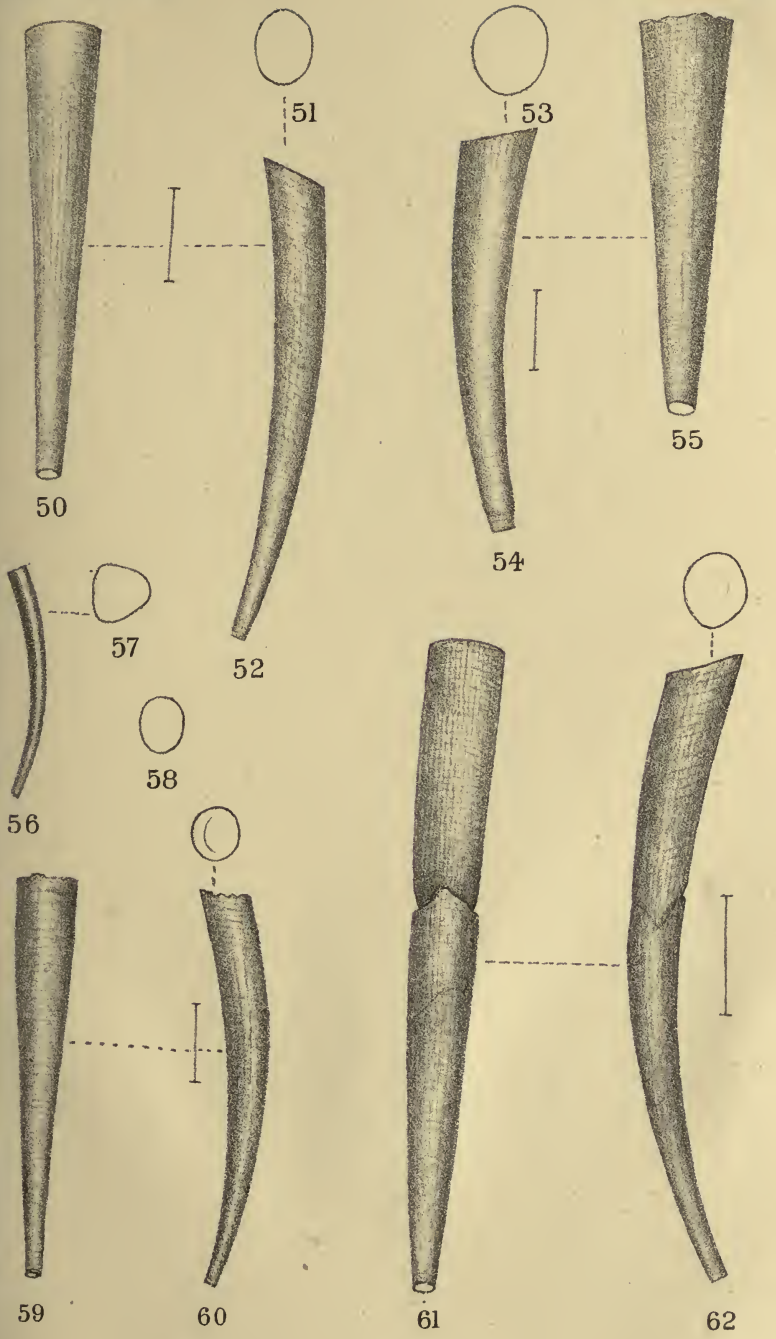
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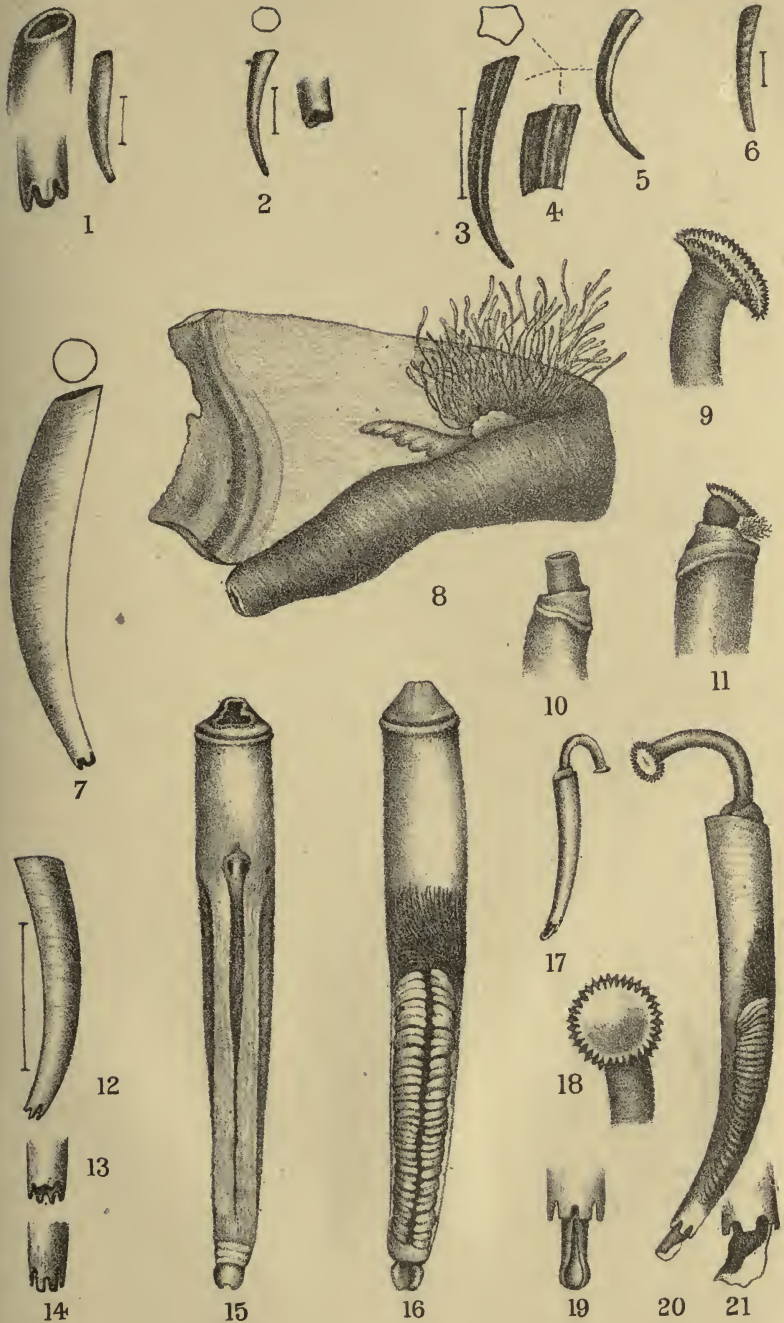
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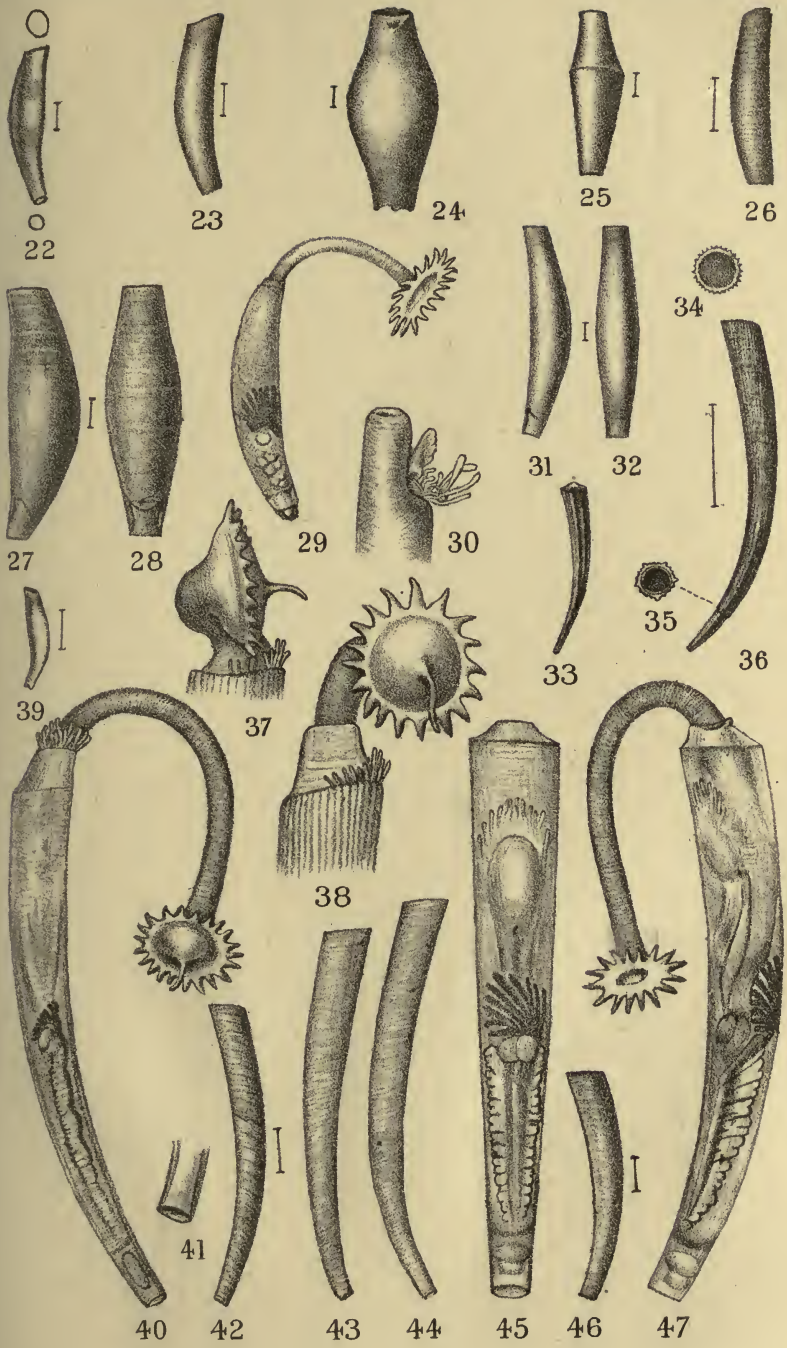
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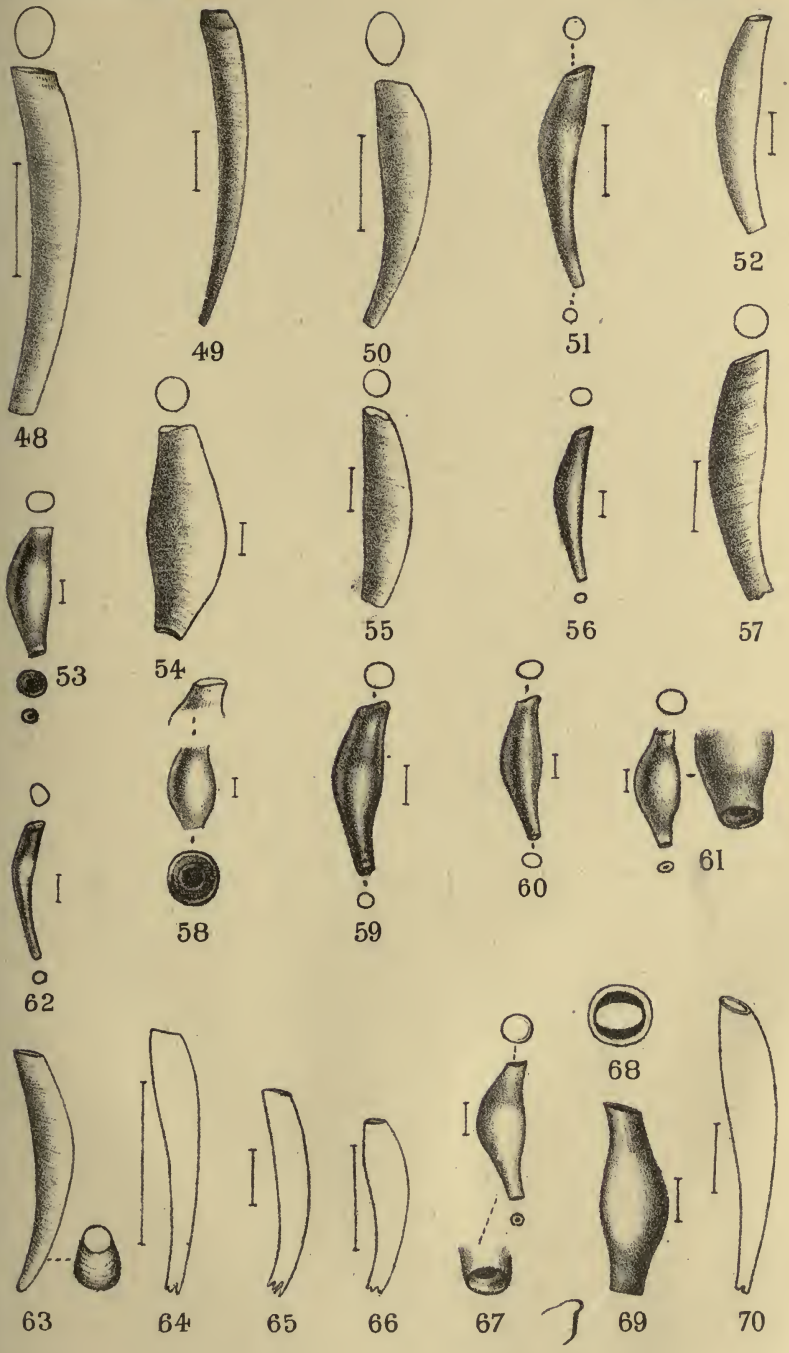
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used. There is a good deal of doubt about Philippi's *D. pusillum;* so much that in the absence of a sufficient diagnosis it need not prejudice the use of Searles Wood's name *polita*, unmistakably fixed as it is by a sufficient diagnosis and good figures.

C. BELCHERI Pilsbry & Sharp, n. sp. Pl. 26, figs. 84, 85, 86, 87.

Shell small, moderately arcuate but the bend mainly posterior, tapering, slightly swollen above the middle, and thence a very little contracted to the aperture. Thin, translucent whitish, slightly flecked with opaque posteriorly. Smooth and glossy, growth-striæ being hardly apparent under the lens. Aperture nearly circular, but a trifle shorter than wide, the peristome oblique, thin. Anal end bilabiate, with a wide triangular fissure on each side.

Length 9·2, diam. at aperture ·95 x 1·0; at greatest girth 1·05 x 1·08; at apex 0·4 x 0·4 mill.

North Pacific (Sir E. Belcher!).

Less abruptly contracted anteriorly and with more open lateral slits than *C. politus* Wood. This is the form mentioned by Jeffreys in P. Z. S., 1882, p. 663. Type is no. 107703 U. S. Nat. Mus., formerly in Jeffreys' collection. *C. dichelus* is a stouter species.

C. DICHELUS (Watson). Pl. 26, fig. 73.

Shell long, slightly swollen at about three-fifths of its length; the swelling bulges on the concave curve, but the convex curve is uninterrupted; between these two curves it is compressed by one-sixth of its breadth, a little contracted in front, bent and attenuated toward the apex; thin, brilliant, white, almost hyaline, with a few minute, transverse, curdy streaks, but weathering to opaque. There is an opaque band round the apex. Sculpture: most faint and delicate microscopic scratches on the lines of growth, with a minute transverse flocculence and some vague indication of longitudinal texture in the substance of shell. The mouth is large, very oblique, with a smoothly rounded edge, which is sharp on the inner margin; both it and the posterior opening are oval. The apex, which is small, is split on either side by a deep, narrow, slightly widening, smooth, clean-cut, but not perfectly regular cleft, which is evidently carried down the shell as the growth of the animal demands, for it cuts across the transverse striæ, as Mr. Searles Wood remarks is the case with *Siphodentalium* (*Dischides*) *bifissum*. Within the opening a short, minute, longitudinal, rib-like process projects along the

middle of the posterior (*i. e.* convex curve) wall; a little farther in, a thin, narrow, circular callus runs round the opening.

Length 0·35 in. breadth at mouth 0·032; broadest 0·055; apex 0·022. (*Watson*).

Levuka, Fiji, 12 fms. (Challenger).

Siphodentalium dichelum Wats., Journ. Linn. Soc. Lond., xiv, p. 521 (1879); Chall. Rep., p. 15, pl. 2, f. 7.

This is much larger than *S. tetraschistum* Wats., and much less cylindrical, being much more contracted towards the mouth. The posterior internal rib is a curious feature. It shows *through* the shell like a crack or depression, but is a true internal rib (*Watson*).

C. prionotus (Watson). Pl. 26, fig. 74.

Shell long, narrow, tapering, gently contracted at the mouth, slightly bent throughout; rather strong, polished, but hardly brilliant, translucent white. Sculpture: very faintly transversely striated on the surface, and a very minute flocculence in the same direction in the texture. For the breadth of the shell the mouth is large, perfectly round, oblique, with a smoothly rounded edge, which is sharp on its inner margin. The apex is small, much chipped, but that in such a way as in all the specimens to produce a shallow rounded hollow on either side, with a sharp, projecting point before and behind. Within the opening a short excessively minute riblet runs out along the middle of the posterior wall; it shines through the shell like a depression, being a little more transparent than the shell-wall.

Length 0·328 in. breadth at mouth 0·028; greatest 0·039; at apex 0·013 inch. (*Watson*).

Raine Island, Cape York, N. E. Australia, 155 fms. (Challenger).

Siphodentalium prionotum Wats., Journ. Linn. Soc. Lond., xiv, p. 522 (1879); Chall. Rep., p. 16, pl. 2, f. 9.

This species differs from the previous [*dichelus*] in being much narrower and having no swelling. From *Siphodentalium tetraschistum* Wats. it differs in being more elongated, more attenuated behind, and in the character of the posterior opening. (*Watson*).

Section Polyschides Pilsbry & Sharp, 1897.

Shell inflated above the middle or not much bulging; apex cut into a number of lobes, generally four, by as many slits. Type *C.* (*Polyschides*) *tetraschistus* Wats.

This group differs from *Siphonodentalium* in having the tube contracted toward the aperture; from *Dischides* in the greater number of terminal lobes, and from *Cadulus* in the presence of slits at the apex. The typical forms have four teeth, dorsal and ventral, and on each side; in a few species the apex is differently incised, having two symmetrically placed side-slits as in *Dischides*, deeper than those above and below. *C. dalli* Pilsbry & Sharp from off western Patagonia, and *C. parisiensis* (Deshayes) from the Parisian Eocene represent this type, which is about intermediate between *Polyschides* and *Dischides*, if not actually nearer the latter group.

Immature specimens have the characters of *Siphonodentalium;* and when the apical lobes are broken off the shell is like the *Gadila* or *Helonyx* manifestations of *Cadulus*.

Polyschides species of the typical quadridentate form appear numerously in the Eocene, together with species of the type of *C. dalli* and of *Dischides*.

Key to Species.

I. Shell slowly tapering, hardly inflated, the apertural contraction slight and short; apex large, cut into 4 bevelled teeth by 4 subequal slits; length 6½–10 mill., about 7 times the greatest diameter.

a. West Atlantic and Gulf of Mexico species, *tetraschistus, quadridentatus, incisus*, p. 148.

a'. Californian species, *quadrifissatus*, p. 150.

II. Shell quite noticeably or strongly inflated, with marked contraction toward aperture; apex 4-slit or notched; known species West Atlantic.

a. Small, moderately swollen, fusiform, with a long, gentle taper toward each end; teeth large; length 5 to 5.6 mill., 5½ times greatest diam., *tetrodon*, p. 151.

a'. Larger, moderately swollen anteriorly, attenuated posteriorly, circular in section throughout; length 7½–10 mill., 6 times greatest diam., more or less; 4 short teeth, *carolinensis*, p. 152.

a''. Large and stout, the greatest inflation at the anterior third; aperture broad-elliptical; 4 rounded apical teeth; length 15 mill., about 4⅓ times the greatest diam., *grandis*, p. 154.

a'''. Large, strongly swollen close to the oblique, markedly contracted and oval aperture; a moderately deep apical notch on each side and smaller ones above and below; length 22 mill., 5½ times the greatest diameter,

spectabilis, p. 153.

III. Moderately inflated anteriorly; apex with a deeper notch on each side, the margin along convex side subdivided into 2, that along concave side into 3 rounded teeth; length 11–14 mill., about 5½ times the greatest diam. Off west coast Patagonia,

dalli, p. 155.

C. TETRASCHISTUS (Watson). Pl. 23, fig. 1.

Shell cylindrical, tapering, bent and attenuated from about the middle to the apex; toward the mouth very slightly contracted. It is rather strong, and has the dull gloss and white translucency of a quill. There are two opaque bands round the apex.

Sculpture: There are traces, exceedingly faint, of fine close-set striæ, which run elliptically round the shell on the lines of growth, and in some lights there is just a reflection as of some sort of remote longitudinal texture (very like that in *Siphodentalium* (*Dischides*) *bifissum* Wood). The edge of the mouth slopes backward very obliquely from the concave to the convex side of the shell; it is thick, and all round it is smoothly rounded off. The apex projects on the convex side of the shell, and is split by four opposite, shallow, unequal, irregular, rough-edged, gaping clefts, so arranged as to leave the teeth at the convex and concave curves and at the two sides. The bands round the apex are two narrow, callus-like internal ribs. Length, 0·298 inch; breadth at mouth, 0·03; at broadest, 0·035; at apex, 0·017 inch (*Watson*).

Anchorage off Fernando Noronha, 25 fms. (Challenger).

Siphodentalium tetraschistum WATSON, Journ. Linn. Soc. Lond., xiv, p. 521 (1879); Chall. Rep., p. 15, pl. 2, f. 8.

Siphonodentalium quadridentatum DALL, Bull. Mus. Comp. Zool., ix, p. 36 (July, 1881).—*Cadulus quadridentatus* DALL, Blake Gastropoda, p. 428, pl. 27, f. 5 (1889); Trans. Wagner Inst. Sci., iii, p. 445 (1892); Bull. U. S. Nat. Mus., No. 37, p. 76, pl. 41, f. 20 (1889); Proc. U. S. Nat. Mus., xii, p. 295.—*C. incisus* BUSH, Trans. Conn. Acad. Sci., vi, p. 471, pl. 45, f. 20 (June, 1885).

C. tetraschistus is the senior or earliest-described member of a group of closely allied forms having similar 4-cleft apices, from the

western Atlantic, extending off the east coast of the United States to the island Fernando Noronha off Brazil, and with one representative in the Pacific (California). The Atlantic forms differ from one another only in size and length of the teeth; and seem to us to be merely local races or subspecies rather than of specific rank. As others may prefer to retain the several forms as species, we give below full information upon them with the original diagnoses.

Var. QUADRIDENTATUS (Dall). Pl. 23, fig. 7; pl. 28, figs. 1–5.

Shell moderately arcuate, the bend greater posteriorly, not much tapering; milky-bluish, glassy, smooth, the growth-striæ very slight; gradually increasing to a point quite near the aperture, thence slightly contracted. Greatest diameter contained about 7 times in the length of shell. Tube nearly circular in section, slightly compressed vertically. Aperture very oblique, transversely oval. Apex cut into four rather conic teeth, which toward their points are bevelled at the outside edges, by four deep slits; the tooth on convex side longest, the other three subequal in length, that on the concave side widest and obtuse.

Length 9·75, diam. at aperture 1·0 x 1·1; diam. at largest 1·32 x 1·38; diam. at apex 0·75 x 0·76 mill. (specimen from Florida Strait).

Largest specimen of a series from off Cape Fear, 9 mill. long; smallest adult 6·6 mill.

Bermuda (Heilprin); *Cape Hatteras* (U. S. F. C., Rush) *south to west coast of Florida, 30 fms.* (Pourtalès); *Fernando Noronha; and mouth of the Rio la Plata, in 10½ fms.* (U. S. Fish Commission); *Pliocene of Caloosahatchie River, Florida.*

The differences between *C. tetraschistus*, *C. quadridentatus* and *C. incisus* seem to be pretty well covered by the variations observed among individuals dredged off the southeastern U. S. We do not see that there is any considerable or sufficient difference, when the measurements of all are compared. *C. quadridentatus* may be considered a large race or subspecies, and *C. incisus* a form intermediate between the two extremes. As to contour, they are all practically alike. The specimen figured by Dall has the teeth abnormally obtuse, probably from old age and wear. Watson's figure of *tetraschistum* does not show the tooth on convex side as long as it is in perfect North American specimens. We repeat here Dall's original description, and give a copy of his figure, pl. 23, fig. 7.

"This species is best described by comparing it with *S. tetraschistum* Watson, to which it is nearly allied. The present form, which may prove eventually to be a large race of Watson's species, seems to differ from it in its proportionally greater stoutness and actually larger size, in the want of any sculpture on its polished surface, and in the proportionally smaller and narrower slits at the anal end of the tube. The dimensions of *quadridentatum* are: Lon. 10·0, max. diam. 1·3, oral diam. 0·8, anal diam. 0·4 mill. The same in Mr. Watson's species are 7·7, 0·81, 0·75 and 0·4 mill. respectively. His specimens came from Fernando Noronha, 25 fms.; ours is from Pourtalès' dredgings on the west coast of Florida in 30 fms.

"In other respects than those mentioned, Watson's description and figure agree almost exactly with our specimen" (*Dall*, 1881).

The original description here follows of

Var. *incisus* Bush. Pl. 25, fig. 65.

"Shell rather small, slender, somewhat cylindrical, slightly contracted dorsally, just back of the anterior aperture, tapering and curving gradually from about the middle toward the posterior end. It is thin, semitransparent and very lustrous. Anterior aperture is oval and a little oblique; the posterior aperture is very oblique with four narrow very deep notches, two on each side, forming four conspicuous points on the end of the shell. Length of largest specimen 8, diam. anterior aperture 1, posterior aperture 0·5 mill. The other specimen is smaller and more slender, measuring, length 7, diam. anterior aperture 0·8, posterior less than 0·5 mill." (*Bush*).

This form is from the Hatteras region.

C. QUADRIFISSATUS (Carpenter), n. sp. Pl. 29, figs. 10, 11, 12, 13.

Shell arcuate, the bend greater posteriorly, slender, but slightly tapering, not swollen, subtransparent bluish, with a milky band near the larger end; smooth and rather glossy, the growth lines hardly visible; posterior third slowly tapering, the tube then nearly cylindrical almost to the aperture; quite near the latter it is contracted, the contraction greatest on the convex side. Greatest diameter contained about 7 times in the length of the shell. Aperture oblique, transversely oval; apex cut into four conic teeth by the same number of short slits; the tooth on convex side slightly longest, the other three subequal in length, that on concave side wider and obtuse; edges of the teeth somewhat bevelled distally.

Length 8·6 mill., diam. at aperture 0·85 x 1·0, at largest 1·12 x 1·22, at apex 0·65 x 0·7 mill.

San Diego, California, 10 fms. (Henry Hemphill, in Acad. coll.); *San Pedro* (Smithsonian Institution).

Siphonodentalium 4-fissatum CARPENTER, *mss.* label in Smithsonian Institution collection.

Extremely similar to *C. quadridentatus* of the Antillean fauna; but in the Californian species the aperture is somewhat less oblique, the apical slits are shorter, the teeth all more conspicuously bevelled and the tooth on the convex side less elongated. These differences we would hardly hold of specific value were it not for the geographic separation of the two species; still they seem constant so far as our material goes.

The figures and measurements are from a San Diego specimen in coll. Acad. Nat. Sci. Phila. The Smithsonian Institution example, which bore the above name, is somewhat smaller, not fully adult, length 7·2 mill.

C. TETRODON Pilsbry & Sharp, n. sp. Pl. 29, figs. 14, 15, 16, 17, 18.

Shell small, slender, slightly arcuate, translucent and slightly bluish with a white line or band near the apex; but little inflated, the greatest girth at the anterior two-fifths of the length, from this point quite perceptibly tapering toward each end. Outline of concave side a trifle convex in the region of inflation; greatest diameter contained about 5½ times in the length of the shell. Surface glossy, without perceptible growth striæ. Aperture oblique, nearly circular, the blunt peristome a little contracted along the convex margin. Anal orifice rounded-oval, slit into four blunt lobes or teeth, one on the convex side slightly longer, rounded; one on concave side truncated, the two lateral lobes slightly narrower; each more or less bevelled to an edge.

Length 5·6 mill., diam. at aperture 0·57 x 0·6, at greatest inflation 0·95 x 1·0, at apex 0·35 x 0·43 mill.

Length 5 mill., antero-posterior diam. at aperture 0·6, at greatest 0·88, at apex 0·4 mill.

Five miles off Cape Florida, in 8 fms. (Dr. W. H. Rush, U. S. N.).

This species is smaller than *C. tetraschistus, quadridentatus* and *incisus*, and is decidedly more swollen and fusiform, the difference in this respect being particularly conspicuous. In general outline

it is very near Dall's *C. amiantus*, but that species is stated to have "both orifices circular and not notched," and with a length of 5·75 it has a greatest diameter of 1·4 mill., while in a specimen of our species 5·6 in length, the greatest diameter is only 1·0 mill. In other words, the greatest diameter of *amiantus* is contained 4·1 times in the length of the shell, and that of *tetrodon* 5·6 times. The slender specimens of *amiantus* reported from off Cape Florida by Dall may be individuals of our species with the teeth broken off.

Types are No. 71,070 coll. Acad. Nat. Sci. Phila.

C. CAROLINENSIS Bush. Pl. 25, fig. 64; pl. 30, figs. 24, 25, 26, 27.

Shell of medium size, semitransparent (perfectly fresh specimens are almost transparent and glassy, showing the animal quite distinctly), very glossy, bluish-white, nearly circular throughout its entire length. Greatest diameter at about the anterior third, diminishing moderately to the round, very oblique anterior aperture, and backward to the posterior end, at first very gradually and further back more rapidly. Curvature well marked in some specimens, slightly in others, nearly uniform along the convex side; the outline of concave side somewhat, though but slightly, convex along the swollen half or more of the length, concave posteriorly. Greatest diameter contained 5¾ to 6·6 times in the length of the shell. Aperture oblique, subcircular, the peristome inflexed along the convex margin. Posterior aperture very small, round and with four small distinct notches, two on each side; teeth very short.

Length 9·8, diam. at aperture 1 x 1, at greatest inflation 1·6 x 1.6, at apex 0·52 x 0·6 mill.

Length 9·7, antero-posterior diam. at aperture 1·0, at greatest inflation 1·45, at apex 0·5 mill. (specimens).

Length 9·5, greatest diameter about 2·0; anterior aperture 1·0, and posterior aperture 0·4 mill. (*Bush*).

Cape Hatteras, very abundant in 7–48 fms. (U. S. Fish Commission, Rush); *Old Providence* in 382 fms. (Dall); *Vera Cruz, Mexico* (Heilprin & Baker).

C. carolinensis BUSH, in Verrill, Res. Expl. Albatross, 1883, Ann. Rep. Commissioner Fish and Fisheries for 1883, art. xvi, p. 587, (1885); Trans. Conn. Acad., vi, p. 471, pl. 45, f. 19 (June, 1885). —DALL, Rep. Blake Gastr. & Scaph., p. 430 (1889); Bull. U. S. Nat. Mus., No. 37, p. 78.

This species does not attain the dimensions of *C. spectabilis*, and it differs from the *tetraschistus* group in being decidedly inflated. The aperture is formed as in *tetraschistus*.

Specimens in rather poor condition from Vera Cruz, Mexico, are small, length 7·5 mill., but we do not doubt their specific identity with the Carolinian examples, some of which are under 8 mill. long.

Var. BUSHII Dall. Pl. 33, figs. 58, 59.

Shell resembling *C. carolinensis*, but somewhat smaller, more abruptly constricted behind the swollen portion, and with the posterior orifice a little smaller. Length 6·5; max. diam., 1·25 mill.

Barbados, in 100 fms. (Blake.)

Cadulus (*carolinensis var.* ?) *Bushii* DALL, 'Blake' Gastr. and Scaph., p. 430, 1889.

In the present uncertainty as to what constitutes a species in this group, or what is the range of specific variation, it is impossible to say whether this form should be regarded as a species, or as a variety of *C. carolinensis* Bush. (*Dall.*)

The figures are from camera lucida sketches kindly furnished by Dall.

C. SPECTABILIS Verrill. Pl. 25, fig. 64.

Shell very large for the genus, rather strongly curved, especially behind the middle, swollen and somewhat angular and gibbous a short distance back of the aperture. The gibbosity or swelling affects most the dorsal side, but is distinct also on the sides and ventrally; in advance of this swollen part the shell narrows rapidly to the aperture, the decrease being much the greatest on the dorsal side. The aperture is oblique and elliptical in outline, the dorsal margin being distinctly flattened. From the anterior swelling the shell tapers regularly and gradually backward, with an increasing curvature. The posterior opening is not very large, a little flattened, and its margin, when perfect, has a moderately deep notch on each side and a shallower one both above and below. The shell is translucent and the surface is everywhere smooth and polished, but shows irregular alternating bands of lighter and darker shade, due to greater or less transparency of the substance, and there are also faint longitudinal whitish lines visible in the substance of the shell, but not affecting the surface (*Verrill*).

Length, 22 mill.; greatest diameter, 4; breadth of the oral aperture 2; diameter of posterior aperture, 1 mill.

Atlantic, east of New Jersey and Maryland, from "Albatross." Station 2,043 in 1,467 fathoms (lat. 39° 49′, lon. 68° 28′ 30″ to stations 2,174, 2,221, 2,222 and 2, 228 (the latter in lat. 37° 25′, lon. 73° 06′), in 1,525 to 1,594 fathoms (U. S. F. C.). *Near St. Vincent, West Indies, in 464 fms.* (Blake Exp.).

Cadulus spectabilis VERRILL, Trans. Conn. Acad., vi, p. 432, pl. 44, f. 19, (1885).—DALL, Bull. Mus. Comp. Zool., xviii, p. 429 (1889): Bull. U. S. Nat. Mus., No. 37, p. 76, pl. 46, f. 19.

"The specimen from St. Vincent is of a more even ivory white, and rather less attenuated posteriorly than the specimens from New England; otherwise it seems to agree fairly with them (*Dall*).

"The species is remarkable for its great size, exceeding even *C. grandis;* for its gibbous swelling close to the anterior end; and for the rapid and strongly marked contraction of the oral aperture. By the last named feature it is readily distinguished from *C. grandis.* Taken in the largest numbers at Station 2,221, lat. 39° 05′ 30″, lon. 70° 44′ 30″, where about twenty-five specimens occurred, part of them living" (*Verrill*).

C. GRANDIS Verrill. Pl. 25, fig. 66.

General appearance of the shell much like that of *C. pandionis,* but more than twice as large, without the abrupt bulging at the largest part, which is a characteristic feature of the latter, and with a relatively larger posterior aperture.

The shell is, for the genus, large and strong, translucent bluish-white when living, milk-white when dead, with a highly polished surface, only faintly marked by the lines of growth when perfect. The shell is moderately curved, the greater part of the curvature being behind the middle, and is largest at about the anterior third, the decrease being very gentle and regular in both directions, but a little more rapid towards the anterior end. The dorsal side is a little flattened towards the aperture, which is decidedly oblique and very broad-elliptical. The posterior aperture is relatively rather large, circular, with the edge a little thickened and divided into four rounded notches, the two upper ones being usually a little deeper and farther apart than the two ventral ones.

Length of one of the largest examples, 15 mill.; greatest diameter, 3·5; transverse diameter of the oral end, 3; vertical diameter,

2·5; diameter of the posterior end, 1·3 mill. Some specimens exceed these dimensions (*Verrill*).

Off eastern coast of the United States, from "Albatross" Station 2,052, south of La Have Bank, east from Nantucket, lat. 39° 40′ 05″, lon. 69° 21′ 25″, in 1,098 fms., to Station 2,115 near Cape Hatteras, in 843 fms.; at several intermediate stations in 906–1,290 fms. At Station 2,043 in 1,467 fms., one large malformed specimen occurred (U. S. Fish Commission).

Cadulus grandis VERRILL, Trans. Conn. Acad., vi, p. 219, pl. 44, f. 20 (1884).

This species might readily be mistaken for a large form of *C. pandionis*, but it differs from the latter in having a larger posterior aperture, a more nearly circular oral aperture, and especially in the absence of the abrupt bulging at the largest part. The form is usually less curved, although in this respect both species are somewhat variable. This shell is, however, much thicker and in every way more robust (*Verrill*).

C. DALLI Pilsbry & Sharp, n. sp. Pl. 30, figs. 19, 20, 21, 22, 23.

Shell rather large, but little curved, smooth and glossy, but upon revolving the shell a sort of excessively shallow, irregular, longitudinal sulcation may be seen by the play of light on the larger third of the shell, at least in some specimens; bluish-white and slightly translucent, sometimes more opaque upon the dilated portion. Moderately swollen posteriorly, the greatest diam. contained about 5½ times in the length of the shell, equator not defined, at about the anterior third to fourth of the length, in front of that point moderately contracted, behind it rather rapidly tapering. Outline of concave side slightly or not perceptibly convex in the neighborhood of the inflation; otherwise nearly straight along the larger half or two-thirds of the length, concave posteriorly. Tube a trifle compressed vertically in the inflated part, elsewhere nearly circular in section. Aperture slightly oblique, circular or nearly so, the peristome thin and acute. Anal orifice subcircular, the edge with a rather deep incision on each side, the dorsal (concave side) margin cut into three, the ventral (convex) into two rounded lobes or teeth by shallower incisions; a short distance within a slight callous ring may be seen.

Length 13·7 mill.; diam. at aperture 2·0 x 2·1, at greatest inflation 2·45 x 2·56, at apex 0·9 x 0·9 mill. (the antero-posterior dimensions in each case preceding).

Another specimen, figs. 21, 22, 23, measures, length 11·2, diam at aperture 1·66 x 1·66, at greatest 2·22 x 2·22, at apex 0·72 x 0·8 mill.

West Coast of Patagonia at Fish Commission Station 2,783, S. lat. 51° 2′, lon. 74° 8′, in 122 fms. mud, bottom temp. 47°; Sta. 2,784, S. lat. 48° 41′, lon. 74° 24′ in 194 fms., temp. 51°; and at other stations in 258 and 449 fms.; *Magellan Strait* in 369 fms., bottom temp. 46°.

Comparatively few specimens show the terminal teeth; they are usually broken off, leaving only the two deeper lateral slits visible.

The apical slitting, when preserved, is on the plan of *C. parisiensis* (Desh.) in having two deeper lateral slits, but the lobes of the anterior and posterior segments are fewer. None of the Atlantic species with denticulate apices are like this, so far as we can judge by what we have seen and the published figures. The specimen drawn in figs. 21–23 is more contracted towards the mouth than the larger one figured, and is quite circular in section, the other being a mere trifle flattened. *C. dalli* is more inflated than *C. quadridentatus* or *quadrifissatus*.

Types are No. 123,746, U. S. Nat. Mus., from Station 2,783; the smaller specimen figured is one of No. 122,736. The specimens from Magellan Strait are not so large, two measuring, *a*, length 9, greatest diam. 1·8 mill.; *b*, length 10·7, greatest diam. 1·8 mill.

Section CADULUS Philippi, 1844.

Cadulus PHIL., Enum. Moll. Sicil., ii, p. 209. Type *Dentalium ovulum* Phil.

Shell somewhat cask-shaped, short and obese, conspicuously swollen in the middle, tapering rapidly toward both ends: convex on all sides, though less so dorsally. Aperture with simple, thin peristome; anal orifice comparatively large, with simple edge, contracted by a wide circular callus or ledge just within the opening.

Cadulus in the restricted sense comprises the short, obese forms, in which no side of the shell is really concave, although the dorsal is less convex than the other contours, and the apical orifice is contracted by a conspicuous callous ring just within the edge. This callus is also developed in many species of *Polyschides*, *Gadila*, etc., but in these it is situated further within and is a comparatively feeble structure.

The species now known are all Mediterranean and North Atlantic, and are all quite small. This is, geologically, the latest in appearance of the several subordinate groups of the genus.

C. OVULUM (Philippi). Pl. 32, fig. 40, 41.

Shell egg-shaped, inflated in the middle, more convex on one side, very smooth; apertures circular and subequal. Length 3, diam. 2 mill. (*Phil.*)

Bay of Naples (Acton); *Bay of Biscay* (Travailleur Exped., 1880); *Pliocene of Calabria and Sicily; Miocene, Piedmont.*

Dentalium ovulum PHIL., Enum. Moll. Sicil., ii, p. 208, pl. 27, f. 21 (1844); Handbuch der Conch. u. Malac., p. 222 (1853).—O. G. COSTA, Fauna di Napoli, p. 56, pl. 4, f. 3.—*C. ovulum* JEFFREYS, Ann. Mag. N. H. (5), vi, p. 375 (1880); P. Z. S., 1882, p. 666.—MONTS., Nuova Rivista Conch. Med., p. 21.—*C. ovulus* SACCO, Moll. Terr. Terz. Piedm. e Ligur., xxii, p. 115, pl. 10, f. 59–63.

This species is the type of the genus *Cadulus*. Philippi remarks substantially as follows: Shell cask shaped, narrow at both ends, almost circular in transverse section. Greatest thickness not in the middle, but a little nearer the anterior end, which is obliquely truncated and with a circular aperture $\frac{5}{12}$ of a line wide and surrounded by a simple peristome. The orifice at the posterior end is $\frac{4}{12}$ wide, contracted, with a margin within, the peristome incised and crenate. The affinity to *D. coarctatum* is evident, but the much shortened form and large posterior aperture indicate a new genus which may be called *Cadulus*.

A var. *gibba* from the Calabrian Pliocene is described by Seguenza, Form. Terz. Prov. Reggio (Calabria), p. 276, 1880.

C. CYATHUS (Cristofori & Jan.). Pl. 32, figs. 36, 37, 38, 39.

Shell small, thin, but rather solid, short, very much inflated in the middle or slightly nearer the aperture, the inflation less on the dorsal side (fig. 37); rapidly tapering toward each end. Surface glossy, without visible growth striation. Aperture (fig. 36) rounded oval, slightly wider than long, somewhat oblique, its diameter about half that of the widest part of the shell; peristome simple, thin. Anal orifice not much smaller than the aperture, round-oval, not oblique, with a wide callous ring or shelf just within the edge, contracting the orifice (fig. 38).

Length 2·2, antero-posterior diameters, aperture 0·58, greatest 1·21, apex 0·5 mill.; lateral diameters, aperture 0·63, greatest 1·21, apex 0·66 mill.

Italy and Sicily; Pliocene of Sicily and Calabria.

Creseis cyathus De Cristofori & Jan, Catal. rer. Nat., p. 1. —*Cadulus ovulum var. attenuata* Montersato, Notizie Conch. foss. Monte Pellegrino e Ficarazzi, p. 27 (no description).—*Cadulus cyathus* C. & J., Monts., Nuova Rivista, p. 21.—*C.* "*alternatus*" Monts., Jeffreys in coll.

Fossil at various points in the Pliocene. Smaller than *C. ovulum*, not so swollen in the middle of the dorsal part. This is the form found living in the Mediterranean. It is apparently quite distinct from *C. ovulum*. We have not seen Cristofori & Jan's catalogue, and adopt the name *cyathus* from Monterosato, who identifies his *C. ovulum* var. *attenuata* with that species.

The figures represent lateral, ventral and apical views, and outlines of aperture and "equator."

C. ampullaceus Watson. Pl. 25, fig. 58.

Shell small, rounded, but not symmetrical in its two curves, contracted in front, pinched in behind so as to form a short tube, swollen, the fullest bulge lying behind the middle. Pretty strong, polished and translucent white, with an opaque band close to the apex; sculpture none; mouth large, very slightly oblique; edge thin and chipped. Apical opening slightly oval, small, straight, roughened, narrowed inside by a flat, concentrically puckered and margined ring, which occupies nearly half its diameter (0·014 and 0·006 inch). The margin (about 0·001 thick) of this ring is formed by the projecting end of a short pipe (about 0·005 long) which passes up into the interior of the shell. Length 0·08 inch, breadth at mouth 0·02, at broadest 0·047, at apex 0·016 inch. (*Watson*).

Culebra Island, West Indies, 390 fms. (Challenger).

Cadulus ampullaceus Watson, Journ. Linn. Soc. Lond., xiv, p. 529 (1879); Chall. Scaph., p. 23, pl. 3, f. 11 (1885).

This species is not only much smaller than *C. ovulum* Phil., from the Mediterranean, but is obviously very different in form and proportions. It differs from *C. exiguus* Wats. in being much rounder, has no tube anteriorly, is not nearly so elongated posteriorly, and is provided with a distinct posterior pipe. (*Wats.*).

I think it not impossible that *C. gibbus*, which I know only from description and figures, may turn out to be my *C. ampullaceus*. (*Wats.*).

C. GIBBUS Jeffreys. Pl. 24, fig. 24.

Shell barrel shaped, gibbous in the middle, whence there is an abrupt slope towards each end; these are equal in breadth; it is rather solid, glossy and semitransparent; sculpture none; color white. Mouth obliquely truncated; base slightly notched, but not quite perfect. Length 0·1, breadth 0·05 inch. (*Jeffreys*).

Bay of Biscay (Travailleur Exp.) *and North Atlantic* (Porcupine Exp., 1870, Sta. 13).

Cadulus gibbus JEFFR., P. Z. S., 1882, p. 666, pl. 49, f. 10; Ann. Mag. Nat. Hist. (5), vi, p. 375 (no description).

Allied to *C. ovulum* of Philippi, but much smaller and not so oval, and the ends are equal in size. (*Jeffr.*).

C. EXIGUUS Watson. Pl. 25, fig. 6.

Shell very small, short, broad, pinched in and projecting at both ends, very slightly bent, and that almost entirely in front; very much swollen in the middle, bulging on the concave curve, a little more attenuated behind; pretty strong, polished, translucent and white, with an opaque white band round the apex. Sculpture none; mouth large, straight; edge thin and chipped. Apical opening small, straight, chipped, narrowed inside by a minute shelf-like projecting ring. Length 0·076 inch, breadth at mouth 0·016, at broadest 0·035, at apex 0·01 inch. (*Watson*).

Lat. 18° 38′ 30″ N., Long. 65° 5′ 30″ W. Culebra Island, West Indies, 390 fathoms (Challenger).

C. exiguus WATSON, Journ. Linn. Soc. London, xiv, p. 528 (1879); Chall. Report, Scaphopoda, p. 23, pl. iii, fig. 10 (1885).

It differs from *Cadulus ovulum* Phil. in being very much smaller, rounder, and contracted into a tube at either end. (*Watson*).

C. OBESUS Watson. Pl. 25, fig. 53.

Shell short, very broad, narrowed at both ends, little bent, and that almost entirely toward the mouth, very much swollen in the middle, and bulging a good deal on the concave curve, a little more attenuated behind, and very slightly laterally compressed (in the proportion of 14 to a little less than 15). It is pretty strong, polished, translucent white, with one, sometimes two, opaque rings near the apex. Sculpture: a few very vague and faint, distant, transverse lines; mouth rather large, straight; edge thin and much

chipped. Apical opening small and straight, chipped, narrowed inside by a minute shelf-like projecting ring. Length 0·109 inch, breadth at mouth 0·02, greatest 0·04; at apex 0·01 inch. (*Watson*).

Lat. 18° 38′ 30″ N., Long. 65° 5′ 30″ W. Culebra Island, West Indies, 390 fathoms (Challenger).

C. obesus Watson, Journ. Linn. Soc. Lond., xiv, p. 527, 528 (1879); Chall. Report, Scaphopoda, p. 22, pl. 3, fig. 8.—Dall, Bull. Mus. Comp. Zool., ix, p. 36; "Blake" Scaphopoda, Bull. Mus. Comp. Zool., xviii, p. 431.

This is nearly of the same proportions as *Cadulus curtus* except being very much broader; like that too, it is narrowed laterally. I have hesitated very much in making it more than a variety, but on the whole, think it safer to reckon it as distinct. One specimen has its width exaggerated by a gibbous pad of enamel. (*Watson*).

C. tumidosus Jeffreys. Pl. 25, figs. 67, 68, 69.

Shell forming a short spindle, slightly bulging in the middle on the lower or more concave part, and very gibbous on the back or outside, somewhat curved, contracted towards both ends, but much narrower at the base, rather solid, glossy and semitransparent. Sculpture none, except microscopic and close set lines; color whitish; mouth roundish-oval, obliquely truncated or sloping to the back; the inner margin is furnished with a slight circular rib or thickening like that in many species of Helix; base notched on each side, as in *C. subfusiformis*. Length 0·2, breadth 0·075 inches. (*Jeffreys*).

Channel Slope, 557 fms. (Porcupine Exped.); *Bay of Biscay*, 292–1095 fms. (Josephine Exped.); *Azores*, 1000 fms., *and Canaries*, 1125 fms. (Challenger); *90 miles N. of Ceara, Brazil*, in 1019 fms. (Albatross); *Fossil in Pliocene at Messina* (Seguenza).

Cadulus tumidosus Jeffr., Ann. Mag. N. H. (4), xix, p. 156 (1877); P. Z. S., 1882, p. 665, pl. 49, f. 8; Ann. Mag. N. H. (5), vi, p. 317 (1880).—Watson, Chall. Rep., p. 22, pl. 3, f. 9 (1885).—Dall, Proc. U. S. Nat. Mus., xii, p. 295 (1890).

This is much larger and more gibbous than *C. subfusiformis*, and like that species, it varies in shape and size. It has the character on which Monterosato lays stress in generically separating *C. subfusiformis* from *C. ovulum*, viz., in the mouth or anterior opening being more or less thickened inside by a circular rib. Some specimens are faintly or indistinctly striated lengthwise. (*Jeffr.*).

I have failed to see the callus-rib in the mouth to which Jeffreys refers; but there is within the posterior opening a circular rib or narrow sharp ledge, which, from the outside, is seen as an opaque band, but with some difficulty may be seen within as a narrow projecting shelf. The edge of the apex seems to me rather chipped than regularly notched (*Watson*).

This species, known to me by specimens in Jeffrey's collection, is rather more slender than *C. cyathus*.

C. CURCURBITA Dall. Pl. 25, fig. 54.

This little shell is perhaps best described by saying that in form it is about midway between *C. obesus* Watson and *C. tumidosus* Jeffr.; being larger than the former and more evenly tapered from the middle than either. It wants the ledge within the aperture at both ends, is polished, translucent, and without perceptible sculpture; neither of the apertures appear to be oblique; both are circular.

Length 4·0, oral diameter 0·62, anal diameter 0·37 mill.; maximum diameter 1·25 mill. (*Dall*).

Fernandina to Florida Strait, 294–310 fms.

Cadulus curcurbitus DALL, Bull. M. C. Z., ix, p. 35 (1881).—*Cadulus curcurbita* DALL, Bull. M. C. Z., xviii, Blake Rep., p. 431, pl. 27, f. 12d; Bull. U. S. Nat. Mus., No. 37, p. 78.

The single specimen obtained [by the Blake] recalls *C. gibbus* Jeffreys, but is very much larger and differently proportioned (*Dall*).

C. AMPHORA Jeffreys. Pl. 24, fig. 25.

Shell resembling in shape an ancient wine-vessel without handles, bulging towards the middle, gently curved, narrowing towards each end, but more contracted at the base or point, rather solid, glossy and opaque; sculpture consisting of a slight but distinct keel which encircles the shell on the upper two-fifths of its length; that part is somewhat excavated or flattened; no striæ of growth are perceptible. Color white. Mouth circular, not oblique or sloping; base notched on each side. Length 0·1, breadth 0·35 inch (*Jeffreys*).

Atlantic Station 16, Porcupine Exp. 1870.

Cadulus amphora JEFFR., P. Z. S., 1882, p. 665, pl. 49, f. 9.

Section GADILA Gray, 1847.

Gadila GRAY, P. Z. S., 1847, p. 159, for *Dent. gadus* Mont.

Helonyx STIMPSON, Amer. Jour. Conch., i, p. 63 (1865), for *Dent. clavatum* Gld.

Gadus "Montagu? Rang, 1829," CONRAD, Amer. Jour. Conch., ii, p. 75, for *pusillum* Gabb, *subcoarctata* Gabb, *thallus* Conr.; also of GABB and some others. Not *Gadus* Linn. (Pisces). *Ditrupa* of Gabb, Guppy and some other authors. Not *Ditrupa* Berkeley (Vermes). *Dentalium* sp., of some early authors.

? *Loxoporus* JEFFREYS, apparently undescribed, and type unknown (said by Sacco to be *C. subfusiformis* Sars.)

Shell decidedly curved, the general contour convex ventrally, concave dorsally; more or less swollen near the middle or toward the aperture, more tapering toward the apex; apical orifice not contracted by a callous ring, or with the callus far within and weak; edges not slit. Type *C. gadus* Mont.

The synonym *Gadus*, used by some authors for this genus, seems to have originated in a series of errors. The name *Gadus* was used by Montagu for a *species* of Dentalium as he understood that genus. It was never used by him for a genus. Rang, in his Manuel de l'Hist. Nat. Moll., p. 116, 1829, seems to think that Montagu made a genus *Gadus*. It is mentioned by him in the text under "*Cresis*," a new genus of Pteropods. He merely says: "Nous réunissons, par analogie, les genres Vaginelle de Daudin et Gadus de Montagu, connus à l'état fossile." Deshayes adopts *Gadus* Rang for three species of *Dischides* and *Polyschides*, but from his remarks it may be gathered that he would also include the species of *Cadulus* proper.

It need only be added that *Gadus* was preoccupied when Rang wrote, by Linnæus, for a genus of fishes of which the common cod is the type.

Loxoporus Jeffr. seems never to have been recognized by its author in print. The genus loving Italians have adopted it for *C. subfusiformis*, though the etymology suggests rather its pertinence to typical *Cadulus*.

This group, which includes a great majority of the species of the genus, is more attenuated and more bent than typical *Cadulus*, and lacks the apical slits and teeth of *Dischides* and *Polyschides*.

There are several quite strongly marked groups of species, and one, the group of *C. dentalinus*, will probably form a separate section eventually. Meantime, a geographic grouping of the forms, accord-

ing to the scheme given below, will probably be the most generally useful.

I. Species of moderately stout figure.
   1. Species of the Atlantic, Mediterranean and Gulf of Mexico.
   2. Species of west America, Cape Horn to Alaska, p. 177.
   3. Indo-Pacific and Australasian species, p. 182.

II. Needle-shaped species, with the swelling very near the aperture. Group of *C. dentalinus*, p. 188.

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1. *Atlantic, Mediterranean and Antillean species.*

Group of C. subfusiformis.

Small forms, but little swollen, with the greatest diameter situated near the middle of the length.

C. SUBFUSIFORMIS (M. Sars.) Pl. 24, figs. 29, 31, 32.

Shell cylindric, long, subfusiform, only a very little swollen in the middle, a little arcuate, almost equally tapering at each end, thin, pellucid, very smooth, shining, the apical orifice a little narrower than the mouth. Length 2·6, diam. 0·5 mill. (*G. O. Sars*).

Scandinavia, from Finmark to Christiana Fjord, in 40–650 fms. (Sars). *Shetland* (Jeffreys). *Bay of Biscay* (Travailleur). *Palermo* (Monterosato).

Siphonodentalium subfusiforme M. SARS, Forh. Videns. Selskabet, 1865, p. 301–307, pl. 6, f. 36–40; pl. 7, f. 41–44.—*Cadulus subfusiformis* Sars, JEFFREYS, Ann. Mag. Nat. Hist. (3), xx, p. 251 (1867); (4), ii, p. 299, 301 (1868); (4), v, p. 274; vi, p. 74 (1870); (5), vi, p. 375 (1880); P. Z. S., 1882, p. 664.—ARAD. & BEN., Conch. Mar. Sicil., p. 118 (1870).—G. O. SARS, Moll. Reg. Arct. Norv., p. 106, pl. 20, f. 14 *a–b*.

Helonyx subfusiformis and var. *abyssicola* MONTS., Nuovo Rivista Conch. Med., p. 20, 21 (1875). Not *C. subfusiformis* Jeffreys, Brit. Conch., v, p. 196, pl. 101, f. 3 = *C. jeffreysi* Monts.

In *C. subfusiformis* the mouth is circular and abruptly truncated; in *C. jeffreysi* the mouth is rounded-oval and obliquely truncated. Both species occur on the western coast of Norway as well as in Shetland (*Jeffr.*).

Var. *abyssicola* Montersato. Very small, although adult. *Palermo*, in 210 meters.

C. MINUSCULUS Dall. Pl. 32, figs. 42, 43.

Shell minute, fusiform, moderately swollen in the middle, the greatest diameter contained nearly four times in the length of the shell. *Convex outline regularly and strongly arcuate; opposite outline nearly straight,* very slightly convex near the middle and as slightly concave toward each end; lateral outlines as seen in a dorsal or ventral view, strongly arcuate, much tapering toward each end. Greatest girth about median, or a little nearer the aperture. *Tube a little compressed between the concave and convex sides in the middle, subcircular in section toward the ends.* Surface smooth, glossy, whitish. Aperture hardly oblique (broken in the specimen seen), circular. Anal orifice nearly as large as the aperture, subcircular, unslit.

Length 2·33 mill.; antero-posterior diameter of aperture 0·342, of greatest girth 0·58, of apex 0·29 mill.; lateral diameter, aperture 0·342, equator 0·616, apex 0·3 mill.

Off Hatteras in 63 fms. (U. S. Fish Commission).

Cadulus minusculus DALL, Bull. M. C. Z., xviii, Blake Rep., p. 432 (1889); Bull. U. S. Nat. Mus., No. 37, p. 78.

Very similar to *C. subfusiformis* in form and size, but *minusculus* is somewhat stouter, with the aperture less oblique. *C. jeffreysi* is larger with oval apertures, and is more attenuated toward the apex. Our figures and description are from the type, No. 93,122, U. S. Nat. Mus.

C. JEFFREYSI (Monterosato). Pl. 24, fig. 39; pl. 32, figs. 44, 45, 46.

Shell small, thin, quite arcuate, moderately swollen, the greatest diameter contained slightly over 4 times in the length of the shell. Convex side with strongly, regularly arched outline, *concave side with gently but distinctly convex swell in the middle,* concave toward each end. Greatest girth nearly median, but slightly nearer the oral end, the swelling everywhere gentle, "equator" indistinct. *Tube circular in section at the middle, laterally compressed toward the aperture, vertically compressed toward the apex.* Surface glossy, smooth; of a bluish-milky color, a little translucent, becoming more translucent near the aperture. Aperture oval, being *compressed from side to side,* somewhat oblique, the peristome thin. Anal orifice *strongly compressed between the convex and concave sides,* with unslit edges.

Length 3·16 mill.; antero-posterior diameter of aperture 0·37, of greatest swelling 0·766, of apex 0·25 mill.; lateral diam. of aperture 0·45, greatest 0·766, apex 0·342 mill.

Mediterranean Sea, from the Ægean, 130–250 fms., *to Palermo and St. Vito,* 90–200 meters (Monterosato); *Naples* (Acton, *et al.*); *off Bayonne* (De Folin) *and Marseilles; north and east Atlantic from the Canaries* (Challenger), *Josephine Bank and Azores* (Josephine Exp.), *Bay of Biscay* (for var. *tumidula* Jeffr.), *north to Valentia, west of Ireland, Shetland and Norway* (Jeffreys); *west Atlantic, off Martha's Vineyard* in 115 fms. (U. S. Fish Commission), *off Barbados* (Blake); *south Atlantic, St. Helena* (Smith); *Pliocene of Calabria and Sicily.*

Cadulus subfusiformis Sars, JEFFREYS, British Conchology, v, p. 196, pl. 101, f. 3. Not of Sars.—*Helonyx jeffreysii* MONTS., Poche note sulla Conch. Medit., in Atti Accad. Palerm. Sci. (Ser. 2), v, p. 20; Nuova Rivista Conch. Medit., p. 20 (1875); Enum. e Sinon., p. 17; Nomencl. Gen. e Spec. Conch. Medit., p. 34 (1884).—*Cadulus jeffreysi* Monts., JEFFREYS, P. Z. S., 1882, p. 665.—VERRILL, Trans. Conn. Acad. Sci., v, p. 559 (1882); Proc. U. S. Nat. Mus., iii, p. 395 (1880).—DALL, Bull. M. C. Z., xviii; Blake Rep., p. 430 (1889); Bull. U. S. Nat. Mus., No. 37, p. 76.—SMITH, P. Z. S., 1890, pp. 253, 300.—MARSHALL, Journ. of Conch., vii, p. 248.—*C. propinquus* VERRILL, Tr. Conn. Acad., v, p. 558, pl. 58, f. 31, 32. Not of G. O. Sars.—*C. diploconus* SEGUENZA, according to Jeffreys.

Although it varies in size, the shell is always much larger and more swollen than *C. subfusiformis* (*Jeffreys*).

Our figures and description are from a Palermo specimen from the Jeffreys collection, U. S. Nat. Mus., No. 107,704. The var. *tumidula* mentioned by Jeffreys, has not, so far as we know, been described.

C. GRACILIS Jeffreys. Pl. 24, fig. 23.

Shell more curved and cylindrical than *C. subfusiformis* (to which it is evidently allied), not swollen in the middle, but throughout nearly equal in breadth; the mouth slopes more, and has a slight circular rib or thickening within; base broader. Oblique marks of growth are conspicuous. Length 0·2, breadth 0·04 inches (*Jeffreys*).

Bay of Biscay (Travailleur Exped.) *and north Atlantic* (Porcupine Exped.), 652–1,450 fms. *Off San Miguel, Azores,* 1,000 fms., *and*

Canaries, 1,125 fms. (Challenger). *Off Cape Hatteras* in 843 fms. (U. S. Fish Commission).

Cadulus gracilis JEFFREYS, Ann. Mag. N. H. (4), xix, p. 157 (Feb. 1877), and (5), vi, p. 375 (1880); P. Z. S., 1882, p. 664, pl. 49, f. 7.—WATSON, Challenger Rep., p. 20, pl. 3, f. 5 (1885).—DALL, Bull. M. C. Z., xviii, Blake Rep., p. 432 (1889).

It is very like *C. jeffreysi* Monts., but is larger and a little more compressed (in the proportion of $\frac{1}{15}$) between the convex and concave curves as compared with its breadth, which is not the case in *C. jeffreysi*. It is not so swollen, and the posterior opening is larger than in that species (*Watson*).

C. PROPINQUUS G. O. Sars. Pl. 24, figs. 27, 28.

Shell rather solid, pellucid, glassy, slightly curved, conspicuously fusiform, the middle moderately swollen, ventral [convex] side equably arcuate, dorsal side slightly rising in the middle: anteriorly tapering. Aperture little oblique, suddenly contracted behind; apical orifice much narrower than the mouth, circular, with entire margin. Surface very smooth and shining, generally with a subopaque zone anteriorly; there is a readily observable internal, subapical annular fold. Length 3·2, diam. 1 mill. (*G. O. Sars*).

Finmark and west coast of Norway, 100–450 fms. (Sars); *Bay of Biscay* (Travailleur Exped.).

Cadulus propinquus G. O. S., Moll. Reg. Arct. Norv., p. 106, pl. 20, f. 15 *a–b*, and pl. I, f. 5, dentition (1878).—JEFFREYS, Ann. Mag. N. H. (5), vi, p. 375 (1880); P. Z. S., 1882, p. 664. Not *C. propinquus* Verrill, Trans. Conn. Acad., v, p. 558, pl. 58, f. 31, 32.

C. CYLINDRATUS Jeffreys. Pl. 24, fig. 26.

Shell forming a narrow cylinder, slightly contracted at each end, gently curved, thin, transparent and glossy; sculpture none, except a few microscopic and faint lines of growth. Mouth somewhat obliquely truncated, but not thickened; base circular, with numerous minute notches, which are not perceptible to the naked eye. Length 0·325, breadth 0·075 inch. (*Jeffreys*).

Off west coast of Ireland, 1,215–1,475 fms. (Porcupine Exped.); *Bay of Biscay*, 652–1,450 fms. (Travailleur Exp.).

Cadulus cylindratus JEFFR., Ann. Mag. N. H. (4), xix, p. 158 (1877); P. Z. S., 1882, p. 664, pl. 49, f. 6; Ann. Mag. N. H. (5),

vi, p. 375, name only (1880).—VERRILL, Trans. Conn. Acad., vi, p. 220 (1884).

Verrill reports this species from Fish Commission Station 2,041, in 1,608 fms.

C. LUNULA Dall. Pl. 25, fig. 55.

Shell translucent white, smooth, destitute of sculpture; dorsum nearly straight, slightly inflated near the middle; oral end contracted, not flattened, and more slender at the mouth than the posterior end; the shell largest in the middle, and tapering nearly equally to both ends; apertures simple, circular, the oral one oblique and quite contracted in proportion to the rather stout form of the shell, which, but for the curve of the convex side and extreme ends, would be nearly evenly fusiform; there is no gibbosity, and, though the anal aperture is the larger, it seems unbroken. Length 6·0 mill., oral diam. 0·75, anal 0·87 mill.; maximum diam. 1·5 mill. (*Dall*).

Off Cape Lookout, N. C., 18 fms. (Albatross); *Barbados*, in 100 fms. (Blake); *Florida Keys*, in deep water.

C. lunulus DALL, Bull. M. C. Z., ix, p. 35 (1881).—*C. lunula* DALL, Ibid, xviii, p. 431, pl. 27, f. 8 (1889); Bull. U. S. Nat. Mus., No. 37, p. 78, pl. 27, f. 8.

Most like *C. simillimus* Watson, from which it differs in its more even half-moon shape and proportions. (*Dall*).

Group of C. olivi.

Species in which the greatest diameter is at the anterior third or fourth of the length, the shell tapering considerably posteriorly.

C. WATSONI Dall. Pl. 25, fig. 50.

Shell translucent white, polished, showing faintly the annular lines of growth; slightly curved, with the greater portion of the curve in the anal third; tapering rapidly from the oral third to the posterior end; the oral third flattened on the convex side toward the mouth; this portion also tapered laterally in the same direction; oral aperture perceptibly oblique in the most perfect specimen, slightly so in another; the transverse diameter of the mouth very slightly longer than the vertical diameter. Length 13·0, oral diam. 1·5, anal 0·6 mill; maximum diam. 2·25 mill. (measured from front to back); maximum transverse diameter 2·9 mill. (*Dall*).

Yucatan Strait, near Cape San Antonio, in 413 and 1,002 fms. (Blake); *also off Old Providence,* in 382 fms. (U. S. Fish Commission).

Cadulus watsoni DALL, Bull. M. C. Z., ix, p. 34 (1881); xviii, Blake Rep., p. 429, pl. 27, f. 12a (1889); Bull. U. S. Nat. Mus., No. 37, p. 76.—VERRILL, Trans. Conn. Acad. Sci., vi, p. 219 (1884).

It is reported from off Cape Hatteras by Verrill, who compares the species to *C. pandionis.* The greatest diameter is contained 4½ times in the length in *C. watsoni.* In *C. rushii* it is decidedly less, being contained nearly 6 times in the length, and the tube is less compressed at the equator.

C. RUSHII Pilsbry & Sharp, n. sp. Pl. 27, figs. 94, 95, 96, 97.

Shell moderately solid, large, moderately arcuate, the bend mainly posterior; outline of convex side almost evenly arched, but more convex near the larger end; outline of opposite side nearly straight along the anterior half, the posterior half decidedly concave; greatest diameter contained 5½–6 times in the length of shell. Swelling quite moderate, greatest at about the anterior fourth of the length, thence tapering gently to the aperture, and decidedly toward the apex, the posterior half of the shell being conspicuously attenuated. *Tube compressed between the concave and convex sides throughout.* Surface glossy and smooth; opaque white. Aperture quite oblique, subcircular, but viewed in line with the axis of the latter portion of the tube it is oval. Apex small, rounded-oval, its margin even.

Length 11·6; antero-posterior diameter at aperture 1·4, at greatest swelling 1·8, at apex 0·53 mill.; lateral diameter at aperture 1·6, at greatest 2·0, at apex 0·6 mill.

Off Cape Hatteras, lat. 35° 19′ 30″, long. 75° 14′ 12″, in 293 fms. (Dr. W. H. Rush).

The equator is more anterior than in *C. pandionis,* and the swelling decidedly less in proportion to the length of the shell. The tube is less flattened vertically than in *C. watsoni* Dall, the aperture a shorter, rounder oval, and the whole shell more slender.

There is generally no noticeable callous ring within the anal opening, but in some specimens a very slight one, far within, seems to be developed.

C. AGASSIZII Dall. Pl. 25, fig. 57.

Shell translucent white, with more opaque annulations, shining, destitute of sculpture, excepting nearly imperceptible lines of growth,

very slightly curved, the dorsum being nearly straight except at the posterior fourth, oral end very slightly tapered, not flattened; posterior part gently tapering from the anterior third; anal end rather stout, opening simple, circular; oral end thin, mouth forming an angle of 45° with the axis, simple, quite circular; the tube with no pronounced gibbosity. Length 9, max. lat. 2, oral diameter 1·5 mill.; anal diam. 0·75, maximum diam. 2 mill. (*Dall*).

'*Blake*' *Station 5*, in 229 fms. (Blake).

Cadulus agassizii DALL, Bull. M. C. Z., ix, 1881, p. 35; Ibid, xviii, p. 430, pl. 27, f. 12c; Bull. U. S. Nat. Mus., 37, p. 78, pl. 27, f. 12c.

No more specimens of this species have come to hand. It is very like *C. pandionis* Verrill, but has the anterior aperture less oblique, the equator more marked, the posterior part proportionally shorter and less attenuated. It is also smaller than *C. pandionis*. The latter has about the same range as *C. carolinensis*, but has not been found yet south of Fowey Rock, Straits of Florida, where it was collected by Dr. W. H. Rush, U. S. N. (*Dall*).

Var. HATTERASENSIS Sharp & Pilsbry, n. v. Pl. 33, figs. 50, 51, 52, 53, 54.

Shell moderately strong, not much curved, the convex curve more arcuate toward the larger end, opposite outline slightly convex at the anterior third, concave behind and slightly so in front of the convexity. Swelling moderate, greatest near the anterior third of the length, thence tapering considerably toward each end; greatest breadth contained about 4½ times in the length of the shell. *Circular in section from the middle to the aperture, decidedly compressed vertically at the apex.* Surface smooth and glossy; opaque white, irregularly banded obliquely with translucent. Aperture quite oblique, circular, the peristome inflexed along the convex margin. *Anal orifice transversely oval, with a stout callous ring a short distance within.*

Length 7·8 mill.; diam. at aperture 1·1 x 1·0; at greatest inflation 1·67 x 1·76; at apex 0·8 x 0·85 mill.

Length 7·9 mill.; diam. at aperture 1·2 x 1·25; at greatest 1·7 x 1·87, at apex 0·8 x 0·9 mill.

Off Cape Hatteras, lat. 35° 19′ 30″, lon. 75° 14′ 12″, in 293 fms. (Dr. W. H. Rush, U. S. N.).

Probably referable to *C. agassizii* Dall as a variety, but showing some rather prominent features not mentioned in Dall's description.

It is also somewhat allied to *C. watsoni* in shape and proportions, but our form is not "flattened on the convex side toward the mouth," and the equator is subcircular, but little greater in transverse than in vertical diameter. The callous ring within the vertically compressed apical orifice is a conspicuous feature in *hatterasensis*.

C. ÆQUALIS Dall. Pl. 25, fig. 48.

Shell opaque white, polished, without sculpture except a rare line due to growth or some irregularity; very slightly curved with hardly any gibbosity perceptible, such as there is being in the anterior fifth of the shell; anal opening circular, simple, thin-edged, not oblique; anterior opening somewhat oblique, slightly contracted, nearly circular; the shell on the whole tapering regularly toward the posterior end, which is stouter than usual in the genus. Length 15 mill., oral diam. 2 mill., anal 1 mill.; maximum diameter 2·5 mill. (*Dall*).

Near Tortugas, in 339 fms. (Blake).

C. æqualis DALL, Bull. Mus. Comp. Zool., ix, p. 34 (1881); Ibid., xviii, p. 429, pl. 27, fig. 9 (1889); Bull. U. S. Nat. Museum, No. 37, p. 76, pl. 27, f. 9.

This fine species is the least swollen of any of the forms from this region, and only *C. cylindratus* Jeffreys exceeds it in this particular. Its nearest relative is *C. spectabilis* Verrill, which is larger, less cylindrical, more curved and more attenuated behind (*Dall*).

C. OLIVI (Scacchi). Pl. 31, figs. 33, 34, 35.

Shell rather thin, moderately curved, the bend mainly posterior; moderately swollen, the "equator" indistinctly angular, at the anterior third of the length, slightly oblique; thence tapering moderately to the mouth, and more rapidly posteriorly, becoming attenuated toward the apex. Outline of concave side slightly modified, becoming a trifle convex in the region of greatest inflation. Greatest diameter contained 5 times in length of the shell. Tube very slightly compressed between front and back curves. Surface polished, without perceptible growth-striation. Aperture oblique, rounded oval; anal orifice subcircular, its edge even, unslit.

Length 11·7 mill.; diam. at aperture 1·24 x 1·37, at greatest inflation 2·06 x 2·33, at apex 0·48 x 0·55 mill. (the antero-posterior dimensions given first in each case).

Pliocene of southern Italy and Sicily.

Dentalium olivi Scacchi, Not. foss. Gravnia (Ann. Civ., 1835), p. 56, pl. 2, f. 6, *a*, *b* (so quoted by Jeffreys; we have not seen the publication).

? *Siphodentalium hyalinum* Brugnone, Misc. Malac., pt. 2, p. 21, fig. 32 (1876), according to Jeffreys.

Cadulus olivi Scacchi, Jeffreys, P. Z. S., 1882, p. 663; Ann. Mag. N. H. (4), xix, p. 157; also (5), vi, p. 317.

The specimen drawn and described is a Jeffreysian example from the Sicilian Pliocene. The type locality is Gravnia, in southeastern Italy. It is still somewhat doubtful whether the species has been found living. Jeffreys certainly confused at least three species under the name *C. olivi* at various times. We are disposed to believe that his "*olivi*" with apical slits and a thickened rim around the mouth belonged to some other species. He refers *C. pandionis* to *olivi* as a synonym, but we do not think them identical. His localities for recent specimens are: *Florö, Norway* (Norman); *Bay of Biscay; Palermo* (Monts.) *west of Ireland*, 1,230 fms.; *south of the English Channel*, 862 fms. (Porcupine Exped.).

Siphodentalium hyalinum Brugnone, which Jeffreys refers to *C. olivi* as a synonym, is thus described: Shell short, rather broad, cylindric; arcuate, thin, very smooth and very shining; anterior part obscurely attenuated; aperture round, oblique; apex broken. Length 8 mill. Ficarazzi. This was described from one specimen and seems a rather doubtful form. Brugnone's figure is reproduced on pl. 33, fig. 61.

C. pandionis Verrill & Smith. Pl. 25, fig. 63.

Shell very large for the genus, white, transparent, very smooth and polished, shining, strongly curved, largest in front of the middle, with the aperture oblique; sculpture none, the shell is somewhat transversely elliptical in section, slightly gibbose and most swollen at about the anterior third, on the convex side; from this point gradually tapering to the slender posterior end and to the mouth, which is slightly broader than high, and recedes considerably on the convex side of the shell, with a thin, smooth margin. Posterior opening small, with a semicircular notch above and below. Length 10, breadth 2·25, breadth of aperture 1·75, of anal aperture 0·40 mm. (*V. & S.*)

South of Nantucket, east of New Jersey, at numerous stations near 40° N. lat., 85–500 fms. (Albatross).

Cadulus pandionis V. & S., VERRILL, Amer. Journ. Science, xx, pp. 392, 399 (Nov. 1880); Proc. U. S. Nat. Mus., iii, p. 395 (1880); Trans. Conn. Acad., v, p. 558, pl. 58, f. 30, 30*a*; Rep. Commissioner Fish and Fisheries, for 1883, appendix D, Nat. Hist., p. 573 (71), pl. 28, f. 126 (1885).

C. POCULUM Dall. Pl. 33, figs. 56, 57.

Shell solid, opaque white, strongly arcuate, the bend mainly in the posterior half. Equator at the anterior fifth, the swelling being short and high, *subangular on the convex side*, in front of it the tube is *conspicuously compressed* between the convex and concave sides, and behind it regularly tapering to the apex; outline of the concave side slightly convex in the region of the equator, elsewhere concave; lateral outlines much contracted above. Surface polished, smooth. *Aperture extremely oblique*, subcircular, but if viewed from above in the line of the axis of the latter part of the shell, appearing *transversely elliptical*. Anal orifice small, subcircular, with thick, slitless walls.

Length 12·2, antero-posterior diameter at aperture 1·2, at equator 2·11, at apex 0·8 mill.; lateral diam. at aperture 1·65, equator 2·45, apex 0·83 mill.

Off Cape San Antonio, Cuba, in 640 fms.; *near St. Vincent, West Indies*, in 464 fms. (Blake).

Cadulus poculum DALL, Bull. Mus. Comp. Zool., xviii, Blake Rep., p. 429 (1889).

The figures represent the lateral and convex aspects. "This species is remarkable for the obliquity of the equator and of the slope on the convex side from the summit to the anterior margin. In these particulars it is more strongly marked than any other species I have seen." *C. platystoma* is stouter and not angularly humpbacked like *C. poculum*. Figures and description from a specimen in National Museum.

C. VULPIDENS Watson. Pl. 25, fig. 51.

Shell like the canine tooth of a small Carnivore, long, sharp, bent, swollen (a little obliquely) toward the mouth. The swelling is greatest on the convex curve, and lies there a little nearer the end (about one-fourth of the length) than it does on the concave, where it is at about one-third of the length. The obliquity makes the form a little unsymmetrical. From the swelling the shell contracts more rapidly towards the mouth. Toward the apex the bend increases,

and the end of the shell is a very little contracted. The shell is pretty strong, brilliant, opaquish white. Sculpture: Very minute, but sharp, microscopic scratches on the lines of growth. Mouth small, round, obliquely truncated backward toward the convex curve. Edge thin and sharp. Posterior opening round; the edge thick, flat, slightly gnawed and broken, projecting a little on the convex curved side. Length 0·35 inch, breadth at mouth 0·039: at swelling 0·069; at apex 0·03 inch (*Watson*).

Culebra Island, West Indies, 390 fms. (Chall.).

Cadulus vulpidens Wats., Journ. Linn. Soc. Lond., xiv, p. 524 (1879); Chall. Rep., p. 18, pl. 3, f. 2.

This is smaller and less symmetrical than *Cadulus colubridens,* and the mouth is much smaller. Than *Dentalium clavatum* Gould, which it much resembles, this is more contracted in front and less so behind, and has more of angulation in its tumidity. Than *Cadulus gadus* Mont., this is a much less stumpy shell, being less swollen in the middle and more drawn out before and behind; it is also straighter. *Cadulus ventricosus* Bronn has the swelling nearer the mouth (*Wats.*).

C. sauridens Watson. Pl. 25, fig. 56.

Shell long, narrow, scarcely bent, swollen very slightly near the middle of the convex curve, just perceptibly and a little more anteriorly on the concave; both the bend and the contraction are greater towards the apex than towards the mouth. There is a very slight compression between the back and the belly of the shell; it is thin, brilliant, scarcely opaque, white. Sculpture: There is none, except perhaps some very faint microscopic traces of longitudinal texture. Mouth rather small, very oblique; edge thin, but not chipped. Apical opening small, straight across the shell, thin, chipped. Length 0·12 inch, breadth at mouth 0·01, at swelling 0·02, at apex 0.009 inch. (*Watson*).

Culebra Island, West Indies, 390 fms. (Challenger).

Cadulus sauridens Wats., Journ. Linn. Soc. Lond., xiv, p. 525 (1879); Chall. Rep., p. 19, pl. 3, f. 4 (1885).

This differs from *Cadulus rastridens* Wats., in being less bent, less swollen, the swelling more central, more apparent on the convex curve; the shell is less attenuated posteriorly and more so anteriorly; there is no transverse sculpture; the mouth here is oblique,

the shell at the anal opening is not thickened, and both ends are narrower. Than *Cadulus gracilis* Jeffr., this is much smaller, more attenuated, has a gibbous swelling, and not a mere equable enlargement, and has both openings much smaller.

From *Cadulus jeffreysi* Monter., it differs still more strongly in these very respects, except that in size it is nearer.

C. AMIANTUS Dall. Pl. 25, fig. 52.

This species, first identified by me with *C. sauridens* Watson, was submitted to Mr. Watson for examination. He writes: "Compared with *C. sauridens* it is three times as long, mouth not oblique nor regular; form much more bent, swelling much more pronounced and nearer the anterior end. The transverse contour line is more circular, there being little if any flattening between the convex and concave slopes. It is more like *C. vulpidens* Watson, but is only half the length of that species, and less conical behind the 'equator,' and more conical in front of it. The equator is less angulated than in *C. vulpidens*, and not so near the mouth." The length of *C. amiantus* is 5·75, its maximum diameter 1·4 mill. Both orifices are circular and not notched, and the swelling evenly shades off toward the extremities. The specimens obtained off Cape Florida are more slender than the typical form. (*Dall*).

Off Cape San Antonio, Cuba, in 1,002 fms. (Blake); *off Cape Florida,* in 8 fms. (Dr. W. H. Rush).

Cadulus sauridens DALL, Bull. M. C. Z., ix, p. 36 (1881); not of Watson, 1879.—*Cadulus amiantus* DALL, Bull. M. C. Z., xviii, Blake Rep., p. 431, pl. 27, f. 7.

C. RASTRIDENS Watson. Pl. 25, fig. 62.

Shell like the tooth of a rake, small, narrow, bent, swollen, and on the convex curve very faintly angulated at about five-eighths of its length, from which point both the bend and the narrowing of the shell is greater (proportionally) toward the mouth than it is toward the apex. Between the back and the belly there is a very slight compression of the shell. It is pretty strong, brilliant, more or less obscurely banded transversely with alternate equal threads of opaque and transparent white. Sculpture: Very faint, superficial, transverse scratches. Mouth pretty large, not at all oblique, thin, sharp and chipped; posterior opening round, straight; edge thickened, and less chipped than the mouth. Length 0·119 inch,

breadth at mouth 0·015, at swelling 0·023, at apex 0·01 inch. (*Watson*).

Lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W., Culebra Island, West Indies, 390 fms. (Challenger).

C. rastridens Watson, Journ. Linn. Soc. Lond., Vol. xiv, p. 525 (1879); Chall. Report, Scaphopoda, p. 19, pl. 3, fig. 3 (1885).

C. curtus Watson. Pl. 25, fig. 60.

Shell short, broad, narrowed at both ends, scarcely bent, and that almost wholly near the mouth; swollen in the middle, so as to bulge a little on the concave curve. Though the mouth is larger than the apex, the whole shell is a little more pinched in front than behind, and is very slightly laterally compressed (in the proportion of about 14 to 15). It is thin, polished, translucent white, with one, sometimes two opaque rings near the apex. Sculpture: Only under a high power of the microscope can some very close transverse striæ be seen in the texture of the shell. Mouth rather large, very slightly oblique; edge thin and generally much chipped; apical opening small, straight, chipped. The opaque rings result from thickening, caused by a thin projection which narrows the opening. Length 0·1 inch, breadth at mouth 0·019, greatest 0·03, apex 0.012 inch. (*Watson*).

Lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W., Culebra Island, West Indies, 390 fms. (Challenger).

C. curtus Watson, Journ. Linn. Soc. Lond., xiv, p. 527 (1879); Chall. Report, Scaphopoda, p. 21, pl. iii, fig. 7.

Than *C. curtus* var. *congruens* Wats., this is not only very much smaller, but here the mouth is oblique, and the shell is straighter behind and more bent in front, where, too, it is much more pinched in. It is nearly of the same length as *C. obesus* Wats., but is very much narrower. (*Wats.*).

Var. congruens Watson. Pl. 25, fig. 59.

This differs from *Cadulus curtus* Wats., in being one-third larger, the mouth is, perhaps, less oblique, but being in both specimens much chipped, this may be accidental. The most remarkable feature of difference is that it is perfectly round, and not like the other, laterally compressed; I attribute this difference to age. At all

events, in the absence of a larger series of specimens, I believe it safer to include both under one species. (*Watson*).

Station 24, lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W., Culebra Island, West Indies, 390 fathoms.

C. curtus var. congruens Watson, Journ. Linn. Soc. Lond., Vol. xiv, p. 527 (1879); Chall. Rept., Scaphopoda, p. 21, 22, pl. 3, fig. 7a.

C. senegalensis Locard.

Shell of relatively large size, of strongly conoid form, rather short and stout, quite arcuate throughout, a little contracted at base, tapering slowly and progressively toward the apex; inferior region terminating in a transversely oval section in a quite oblique plane, contracted for a distance apparently equal to one-tenth the total length, in such a manner that the maximum inflation of the shell is well downward and at the same time but little prominent; anterior and posterior profiles subsymmetrical; shell rather thin, solid, subopaque, of a dirty ivory white tint after death of the animal, very glossy, appearing completely smooth. Length 20, maximum diam. 3·5, curvature 1·5 mill. (*Locard*).

Senegal, 3200 meters depth.

Cadulus senegalensis Loc., L'Echange Revue Linnéenne, Jan., 1897, p. 3.

C. strangulatus Locard.

Shell of small size and narrowly elongated subcylindroid form, little inflated, feebly arcuate, conspicuously more contracted in the superior region than in the inferior; superior region very short, terminating above by a slightly oval section in a noticeably oblique plane; inferior region delimited, quite high, terminating in a feebly oval section in a decidedly oblique plane. Anterior profile nearly straight, very feebly arcuate above, a little salient below the median region; outer profile very plainly arched, continuous above, with the edge of the superior region, the maximum bulging a little below the middle, shell thin, quite solid, subtransparent, becoming opaque white after death, smooth and glossy. Length 4·5, greatest diam. 1, least 0·5 mill. (*Loc.*)

Gulf of Gascony and off Marseilles, between 555 and 2018 meters depth.

Cadulus strangulatus Loc., L'Echange, 1897, p. 4.

C. MONTEROSATOI Locard.

Shell of subtruncate conoid ("*subtronconoide*") form, but little arched altogether, strongly swollen in the region above the middle. Superior region very short, a little more constricted than the inferior, terminating in a circular section in a horizontal plane; inferior region short, but a little longer than the superior, terminating in a noticeably oval section in a slightly oblique plane. Anterior profile undulating, feebly projecting above the middle; posterior profile notably more arched, with the greatest convexity a little above the middle, more abruptly tapering upward than downward, Shell somewhat thin, quite solid, subtransparent, smooth, very glossy, becoming a porcelain white after death. Alt. 6, greatest diam. 2, least 1 mill. (*Loc.*)

West of Cape Finistere, 2018 meters depth.

Cadulus monterosatoi Loc., L'Echange, 1897, p. 4.

C. ARTATUS 'Jeffreys' Locard.

Shell of narrowly subconoid shape, well curved, and inflated throughout the median region; superior region more constricted than the inferior and more lengthened, terminating in a perceptibly circular section, in a slightly oblique plane; inferior region a little greater in diameter, a little shorter, terminating in a distinctly oval section, in a plane perpendicular to the long axis of the shell. Anterior outline regularly arched, with a slight swelling a little below the middle; posterior outline well arched, with a very regular, very long swelling, making a nearly continuous curvature of the superior and inferior regions, the greatest convexity a little below the middle. Shell rather thin, fragile, subtransparent, diaphanous, becoming opaque with death of the animal, smooth and glossy. Alt. 4, greatest diam. 0·75, least 0·5 mill. (*Loc.*)

Gulf of Gascony, 1019 to 2651 meters depth.

Cadulus artatus Jeffreys, LOCARD, L'Echange 1897, p. 4.

CADULUS SEMISTRIATUS and C. ARTATUS Jeffreys, Ann. Mag. N. H. (5), vi, p. 317, are merely list names, which Jeffreys did not make good by descriptions. Locard has lately given a diagnosis of the latter, translated above.

Species of the West Coast of North and South America.

I. Shell large (about 24 mill. long), longitudinally striated.

a. Striæ close, even, deeply engraved; length 7 times the greatest diameter, *albicomatus*, p. 178.

a'. Striæ slight, shallow, less evenly developed; length 8½ times the greatest diameter. *striatus*, p. 179.

II. Shell smaller, not striated longitudinally.

a. Species of stout or rather stout figure, the inflation moderate or conspicuous, greatest diameter at the anterior third or fourth of the length.

b. Tube approaching circular in section at aperture and equator, *californicus*, p. 180; *tolmiei*, p. 181.

b'. Tube markedly flattened at aperture and equator, *platystoma*, p. 180.

a'. Very slender species, with the slight inflation anterior, contraction toward the mouth very short; diameter contained 7–10 times in the length.

b. Shell smooth throughout; anterior contraction slight.

c. Length 13·5 mill., 10 times the diam., *aberrans*, p. 193.

c'. Length 10·3 mill., about 9 times the diam., *fusiformis*, p. 193.

c''. Length 10 mill., about 7 times the diam., *hepburni*, p. 194.

b'. Shell circularly corrugated near the apex, *perpusillus*, p. 190; *panamensis*, p. 191; *major*, p. 192.

C. ALBICOMATUS Dall. Pl. 35, fig. 15.

Shell resembling *C. spectabilis* Verrill, but larger, with a less prominent equator, more compressed in an antero-posterior direction, and with the anal opening produced at the sides and roundly excavated in front and behind instead of notched laterally and produced medianly. Color milk-white; incremental sculpture indicated only by more or less translucent rings in the shell substance; *longitudinally sculptured by extremely fine sharp grooves with equal interspaces, which cover the whole of the shell;* curvature moderate, nearly uniform, slightly more marked near the anal end; the whole shell distinctly compressed, though not flattened, except below the oval aperture, where the shell is impressed, making a shallow sulcus extending backward nearly two millimeters, and in front arching the margin so that the perfect aperture is distinctly uniform with sharp, thin edges. There is no swollen equatorial girdle; the greatest diameter is near the posterior end of the above-mentioned

sulcus, whence the shell tapers evenly backward; aperture slightly oblique; anal aperture nearly circular, concavely arched, but not notched in front and behind; longitude of shell on its dorsal chord, 24; perpendicular to the chord, 2; diameter of oval aperture, 3; antero-posterior diameter, 1·5; diameter of anal aperture 1; maximum diameter of shell, 3·4; antero-posterior diameter of shell, 3 mill. (*Dall*).

Off Manta, Ecuador, about 40 miles south of the equator, in lon. 81° W., 401 fms.; *Gulf of Panama*, 1,672 fms. (Albatross).

Cadulus albicomatus DALL, Proc. U. S. Nat. Mus., xii, p. 259, pl. 9, f. 8.

This species was obtained about 40 miles south of the equator in west longitude 81°. It is one of the largest and finest species of the genus, and the only one known to me which is distinctly longitudinally sculptured (*Dall*).

The longitudinal striation is similar to that of *Dentalium calamus*, but rather finer. The grooves are very regularly and rather deeply engraved.

C. STRIATUS Dall, n. sp. Pl. 35, figs. 9, 10, 11, 12, 13.

Shell very large, rather slender, moderately bent; bluish-white, more opaque white near the apex and upon the most inflated portion; surface glossy, seen under a lens to be *densely and finely striated longitudinally*, the striation subobsolete near apex and aperture. Tube without any pronounced inflation, somewhat compressed between the convex and concave sides, gradually increasing from the apex nearly to the aperture, then *then abruptly depressed or contracted on the convex side*, with a small, flattened, slightly concave area just behind the lip; slightly contracted laterally but not on the concave side. Aperture oblique, oval, somewhat flattened on the convex side; peristome acute, excised on the convex side. Anal orifice simple, subcircular, the edge excavated in front and behind (fig. 12).

Length 24·8 mill.; diam. at aperture 2·0 x 2·5, at largest 2·7 x 2·9. at apex 1 x 1·2 mill.

Gulf of Panama, in 322 fms. (Albatross).

Very similar to *C. albicomatus* Dall, but the longitudinal striæ which in that species are close, even and deeply engraved, are here more slight, shallow, less regularly and evenly developed. It is also a more slender species. Numerous specimens were taken at Fish

Commission Station 3,354, in the Gulf of Panama. Types are No. 122,992, U. S. Nat. Mus.

C. PLATYSTOMA Pilsbry & Sharp, n. sp. Pl. 35, figs. 17, 18.

Shell rather large, *much bent;* bluish-white, somewhat translucent posteriorly; smooth and glossy, growth-striæ being scarcely discernable. Strongly swollen posteriorly, the greatest diameter contained about 4·4 times in the length of the shell; equator between the anterior third and fourth of the shell's length, the tube rapidly tapering posteriorly, less rapidly anteriorly, where it is *decidedly depressed or flattened on the convex face,* the flattening increasing toward the aperture, just behind which there is a slight concavity on the middle of the convex side (fig. 18). Outline of convex side decidedly more arcuate toward the aperture; concave outline modified and slightly convex in the region of the inflation. Posterior end attenuated. Tube compressed between the concave and convex sides at and anterior to the inflation, subcircular in section at the apex. *Aperture irregularly elliptical, much flattened along the convex side,* the peristome thin, jagged from fracture. Anal orifice subcircular, with simple edge.

Length 12·7; diam. at aperture, 1·3 x 2.0, at greatest inflation 2·52 x 2·92, at apex 0.8 x 0·8 mill. (the antero-posterior dimensions preceding).

Off Manta, Ecuador, U. S. Fish Commission Station, 2792 in 401 fms. mud, bottom temp. 42°.9 F. (Albatross).

Somewhat like *C. poculum* in being much bent, with the tube markedly compressed anteriorly, but in the Pacific species the inflation is much more extensive and not angular, the posterior attenuation less great, etc. It differs from *C. dalli* in being more bent, without apical nicks, and conspicuously in the shape of the aperture. In the form of the aperture it is somewhat similar to *C. albicomatus,* but that is a sculptured species.

The unique type is No. 107,699, U. S. Nat. Mus.

C. CALIFORNICUS Pilsbry & Sharp, n. sp. Pl. 34, figs. 5, 6, 7, 8.

Shell large and solid, well curved; smooth and glossy, growth-lines being very faintly indicated; opaque white, the posterior half bluish, subtranslucent, with a similarly colored rim at the mouth, or sometimes slightly bluish throughout. Stout, decidedly swollen anteriorly, the greatest diameter contained $4\frac{1}{2}$ to $4\frac{2}{3}$ times in the length of shell; the equator about at the anterior fourth, either oblique,

well-marked and slightly subangular or less distinct and gently rounded, tapering rapidly toward both ends; outline of concave side noticeably convex in the region of greatest swelling. Section of tube a trifle flattened between the convex and concave sides at the equator or throughout. Aperture subcircular, somewhat oblique. Anal orifice rather large, slightly oval, with no noticeable callus within, its edge irregular from breakage, but possibly two lateral nicks (see fig. 7) may be normally present.

Length 14·3 mill.; antero-posterior diam. at aperture 2·25, at largest 3·33, at apex 1·0 mill.; lateral diam. at aperture 2·3, at largest, 3·4, at apex 1·1 mill.

A more slender specimen measures: length 14·6, diam. at aperture 2·3 x 2·5, at largest 2·9 x 3·1, at apex 1·2 x 1·4 mill.

Off Tillamook Bay, Oregon, in 786 fms., bottom temp., 37°.3; *off Cape St. Martin, California,* in 218 fms., temp., 43°.2; *off San Luis Obispo Bay,* 252 fms.; *off Santa Barbara Is.,* 414 fms.; *off San Diego,* in 822 fms., temp., 39°; also *Gulf of Panama,* in 1,270 fms., temp., 36°.4 (U. S. Fish Commission).

A large stout species, much exceeding *C. tolmiei*, *C. clavatus* and *C. dalli* in size, and more swollen and robust than either. The equator is nearer the aperture and more pronounced than in *C. tolmiei* Dall. The Atlantic forms *C. grandis* and *C. spectabilis* Verrill are somewhat similar, but the former is stouter, the latter longer than *C. californicus*. It varies considerable in inflation, some specimens (figs. 7, 8) being decidedly less swollen than that selected as type (figs. 5, 6).

The type specimens are No. 107,698, U. S. Nat. Mus.

C. TOLMIEI Dall. Pl. 34, figs. 3, 4.

Shell thin, polished, slightly bluish-white, a trifle translucent, rather arcuate; moderately swollen, the greatest diameter contained about 5 times in the length, situated about at the anterior third, thence tapering at first gradually and then rapidly to the apex, only slightly contracting toward the aperture; convex side strongly and evenly arched, opposite outline straight along the anterior half, concave posteriorly. Tube a trifle compressed vertically in the middle and anteriorly; sculpture none, or only of obscure, incremental lines. Aperture oblique, nearly circular; anal orifice subcircular, simple.

Length 10·7, antero-posterior diameter at aperture 1·65, at greatest bulging 2·0, at apex 0·77 mill.; lateral diam. at aperture 1·72, at greatest 2·1, at apex 0·72 mill.

Type measures: length of shell, 12·0; max. diam., 2·0; min. diam., 0·7 mill.

Near Victoria, Vancouver Island, in 60 fms., with *C. hepburni* (Nat. Hist. Soc. Brit. Columbia).

Cadulus tolmiei DALL, Nat. Hist. Soc. Brit. Columbia, Bull. No. 2, p. 13, pl. 1, f. 8 (1897).

"This species is markedly different, both in arcuation and the inflation of the anterior part, from either *C. aberrans* or *C. hepburni.* I have named it in honor of the late Dr. William Tolmie, of Victoria, sometime officer of the Hudson Bay Co., who for many years contributed valuable material to the students of the ethnology and natural history of British Columbia, both in America and England." (*Dall*).

C. tolmiei is smaller and less inflated than *C. californicus* Pils. & Sharp, and the equator is less distinct. It is very similar to *C. rushii* from the Hatteras region in the Atlantic, but that is more attenuated posteriorly. With the type a specimen occurred differing in several respects, and probably at least varietally distinct.

C. (*tolmiei* var.?) NEWCOMBEI P. & S., n. var. Pl. 34, figs. 1, 2.

About the length of *tolmiei,* but decidedly more slender, greatest diameter contained nearly 6 times in length, section of the tube markedly oval, compressed vertically throughout; aperture oval. Length 11·0; antero-posterior diam. at aperture 1·45, at greatest bulging, 1·66, at apex 0·66 mill.; lateral diam. at aperture 1·55, at largest 1·9, at apex 0·75 mill.

Indo-Pacific and Australian Species.

C. SIMILLIMUS Watson. Pl. 26, fig. 77.

Shell very like *Cadulus gracilis* Jeffr., rather broad, narrowed at both ends, very slightly and symmetrically bent, but a little more towards the mouth, with a very slight bulge, which just shows on the concave curve. It is thin, polished, translucent (weathering opaque), with an opaque ring near the apex. Sculpture: Very minute and faint and superficial oblique striæ, with a faint flocculence in the substance of the shell. Mouth rather large, oblique; edge thin, but rounded; apical opening small, thin, and chipped. Length 0·16 inch, breadth at mouth 0·02, greatest 0·036, at apex 0·014 inch. (*Watson*).

Raine Island, Cape York, N. E. Australia, 155 fms. (Challenger).

Cadulus simillimus Wats., Journ. Linn. Soc., xiv., p. 526 (1879); Chall. Rep., p. 20, pl. 3, f. 6 (1885).

This differs from *C. gracilis* Jeffreys in being broader, with a slight bulge on the concave curve, in being a little more bent, and in not being compressed; it is also larger. It is extremely like *C. jeffreysi* Monter., but is a little more bent, especially in front, is larger, and seems a thinner shell. (*Watson*).

C. acuminatus Tate. Pl. 32, figs. 47, 48, 49.

Shell quite thin, moderately arcuate and not much swollen, fusiform, *the greatest girth about median*, thence very gradually tapering toward the ends, which are rather large; the median bulging being about as obvious in a dorsal or ventral (fig. 48) as in a lateral view of the shell. Tube *somewhat flattened antero-posteriorly throughout*, the compression slightly greater at the ends. Surface appearing *perfectly smooth* and glossy; *translucent*-whitish throughout, *except for an opaque white ring around the tube a short distance from the smaller end*, produced by a narrow internal callous ledge. Both openings oval, their outlines more flattened on the convex than on the other side, and both cut the tube nearly at right angles; and the peristomes are simple. *Greatest diameter of apex about two-thirds that of the aperture.*

Length 6·4; tube measuring 1·11 by 1·25 mill. at point of greatest diameter; aperture 0·705 by 0·9 mill.; apex 0·564 by 0·66 mill. (figs. 48, 49).

Another specimen (fig. 47) measures: Length 5·2 mill.; antero-posterior diam. at greatest amplitude 0·9, at aperture 0·6, at apex 0·47 mill.

St. Vincent Gulf, South Australia (Tate, Bednall); *Port Stephens, New South Wales* (Dr. J. C. Cox).

Cadulus acuminatus Tate, Proc. and Rep. Roy. Soc. S. Australia, ix, p. 193 (1887).—*C. acuminatus* Desh. MS. in Coll. Cuming, Angas, P. Z. S., 1878, p. 868.

The specific name is singularly inappropriate. Professor Tate described it from the oyster beds of the Upper Aldinga series (Pliocene).

Numerous specimens vary between the more obese and the slender specimens figured. The white girdle near the smaller end is constantly conspicuous on the milky translucent color of the rest of the shell. This girdle is removed from the apex a distance about

equal to the diameter of the latter. There is no thickening of the shell wall toward the aperture, and no appearance of striæ under considerable magnification.

The greatest diameter of the tube is contained about 5 times in the length of the shell; that of the aperture is contained about 7 times.

This species is considerably like the North Atlantic *C. subfusiformis* in contour. *C. simillimus* Wats., is a more swollen species.

C. COLUBRIDENS Watson. Pl. 26, fig. 71.

Shell like an adder's fang, long, sharp, bent, very slightly flattened, swollen near the broader end. The swell, which is faintly angulated and is at one-fourth of the length, is chiefly on the convex curve, but is visible on the concave curve too. From the angulation the curve is very equable in either direction till about two-thirds along toward the apex, where it bends a little more. The shell is thin, brilliant, semi-opaque, white. Sculpture: Very faint and fine scratches on the lines of growth. Mouth large, oval, very slightly flattened on the ventral side, from which the thin, sharp edge is obliquely cut off upwards towards the convex curve. The posterior opening is much smaller, nearly round, and the edge is thin and chipped. Length 0·58 inch, breadth at mouth 0·067, greatest 0·1, at apex 0·033 inch. (*Watson*).

Lat. 37° 34′ S., long. 179° 22′ E., N. E. point of New Zealand, in 700 fms. (Challenger).

C. colubridens WATSON, Journ. Linn. Soc. London, xiv, p. 523 (1879); Chall. Rep., Scaphopoda, p. 18, pl. iii, f. 1 (1886).

This is twice the size of *C. gadus* Montagu, but it resembles that in the angulation, which, however, is here more marked at the summit of the swelling; its expansion from the smaller end is more gradual, and its contraction from the angulation to the mouth is more rapid. (*Wats.*).

C. VIPERIDENS Melvill & Standen. Pl. 33, fig. 55.

Shell of medium proportions, somewhat curved, very smooth, a little tapering towards the apex as well as at the aperture; delicate, pellucid, milk white. Aperture rounded, the margin thin; posterior orifice very small, the margin acutely cut into two lobes, thin. Length 6·5, diam. of aperture 1, of apex 0·5 mill.

Lifu, Loyalty Is. (Mr. & Mrs. Hatfield).

Cadulus viperidens Melv. & Standen, The Journal of Conchology, viii, p. 274, pl. 11, f. 79 (Oct., 1896).

Several specimens of a somewhat incurved, perfectly smooth translucent, milky-tinged *Cadulus*, precisely corresponding with unnamed specimens in the British Museum from the shore of North Australia. In form it slightly recalls *C. colubridens* Wats. from New Zealand, but is more uniform in width and less ventricosa towards the base. It is likewise smaller than either that species, the common tropical *C. gadus* Montagu, or *C. jeffreysi* Monts. The mouth is simple, round, the posterior or apical orifice also rounded in diameter, has its edges labially bisected by a sharply cut channel. (*Melv. & Stand.*).

C. clavatus (Gould). Pl. 26, figs. 80, 81, 79.

Shell rather slender, moderately solid, considerably curved; maximum diameter situated near the larger end, gradually tapering posteriorly, anteriorly rather rapidly contracting at the sides and especially on the convex face, and very slightly on the concave face. Tube slightly flattened between the convex and concave sides throughout, least so at the apex. Bluish-white, becoming opaque-white near the ends from the greater thickness of the shell there. Surface smooth, glossy, showing no striation; aperture (fig. 80) slightly oblique, rounded-oval, a little more flattened on the convex than on the concave side. Apex small, rounded oval, with perfectly simple, sharp edge. Length 11, diameter at aperture 1·2 x 1·4, at greatest girth 1·76 x 1·85, at apex ·55 x 0.6 mill.

Hong Kong Harbor, China, 6–20 fms. (Wm. Stimpson).

Dentalium clavatum Gould, Proc. Bost. Soc. N. H., vii, p. 166 (1859).—*Helonyx clavatus* Stimpson, Amer. Journ. Conch., i, p. 63, pl. 9, f. 14 (1865).

Stimpson has figured and described the living animal (fig. 79): "Foot greatly elongated, cylindrical, and obtuse at the extremity; collar apparently entire; anal siphon longer than in *Dentalium*, not fissured."

Mr. A. H. Cooke reports *C. clavatus* from the Gulf of Suez, dredged by MacAndrew (Ann. Mag. N. H. [5], xvi, p. 275).

Our figures and description are from the type, U. S. Nat. Mus.

C. honoluluensis (Watson). Pl. 26, fig. 76.

Shell cylindrical, bent, and attenuated from about the middle to the apex, toward the mouth very slightly contracted, of a dull white

translucency, and not glossy. Sculpture: The surface, especially toward the apex, is faintly marked by microscopic, remote, oblique, raised, encircling rings, parallel to which there are fine scratches in the intervals. Edge of the mouth very oblique, blunt; apex not small, broken. Length 0·21, breadth, greatest 0·031, at mouth 0·028, at apex 0·016 inch. (*Watson*).

Reefs off Honolulu, 40 fms. (Challenger).

Siphodentalium honoluluense Wats., Journ. Linn. Soc. Lond., xv, p. 89 (1880); Chall. Rep., p. 17, pl. 2, f. 10.

This species closely resembles *Siphodentalium tetraschistum* Wats., but, besides the obvious difference in size, that species is a little more cylindrical and is much more strongly and uniformly sculptured. I say nothing of the peculiar feature of the apex of that species, because the point being broken in the solitary specimen of the present species, comparison is impossible. (*Watson*).

C. gadus (Montagu). Pl. 31, figs. 28, 29, 30, 31, 32.

Shell small, rather thin, but little curved and that mainly posteriorly; anterior half considerably and very regularly swollen, the greatest diameter slightly behind the anterior third of the length; tapering toward the aperture on all sides, a little more rapidly tapering posteriorly, decidedly attenuated toward the small apex. Outline of concave side decidedly modified and quite convex in the region of the inflation. Greatest diameter contained 4⅛ to 4¼ times in the length of the shell. Surface smooth, with a glimmer somewhat like that of *C. incisus;* no perceptible growth-striæ; color whitish, imperfectly translucent. Tube slightly compressed from front to back, throughout. Aperture quite oblique when unbroken, and rounded-oval. Anal orifice very small, of the same shape, its edge apparently free from slits when uninjured.

Length 7·6 mill.; diam. at aperture 0·95 x 1·26; at largest 1·68 x 1·79; at apex 0·47 x 0·48 mill.; the antero-posterior diameter given first in each case.

Length 6·53 mill.; diam. at aperture 0·82 x 0·9; at largest 1·37 x 1·58, at apex 0·33 x 0·42 mill.

Habitat uncertain.

Dentalium gadus Mont., Testacea Britanica, p. 476, pl. 14, f. 7 (1803).—*Cadulus gadus* Mont., Jeffreys, Ann. Mag. N.H. (4), xix, p. 157 (1877).—? *Cadulus gadus* Cooke, Ann. Mag. N. H. (5), xvi, p. 275.—? *C. gadus* Sowb., Melvill & Abercrombie, Mem. & Proc. Manchester Lit. and Philos. Soc. (4), vii, p. 25.

Our figures and description are from specimens in the Jeffreys collection (U. S. Nat. Mus.) which agree thoroughly with Montagu's figures, and which perhaps came originally from Humphrey's stock of shells. The species is quite distinct in its flask-like form, being conspicuously and evenly swollen but not in the least angulated anteriorly, and a good deal attenuated posteriorly. This peculiar and characteristic shape is for some reason more conspicuous in the shells themselves or in a natural size figure, than it is in the much enlarged camera drawings, although the latter are faithful in proportions. Jeffreys writes as follows: "*C. gadus* of Montagu resembles *C. olivi;* but it is not only very much smaller, but is proportionally shorter and less slender, and the anterior end is more contracted. The locality given by Montagu ('many parts of the British Channel'), with the mariner's name 'Hake's-tooth,' is at least very doubtful as regards this species; and it is not unlikely that he may have mistaken for the 'Hake's-tooth' *Ditrypa arietina* (a testaceous annelid), which is frequently found adhering to the grease or 'arming' of the deep-sea lead in soundings. But his description and figure evidently apply to a species of *Cadulus* from the noted collection of old George Humphreys, the shell-dealer, of which I possess specimens. This species was dredged by the late Professor Barrett at Jamaica; and it is a fossil of the Sicilian tertiaries. I received specimens of the latter from the Marquis di Monterosato as '*Cadulus subfusiformis* Sars,' and from Dr. Tiberi as '*Siphonodentalium olivi* var. *minor* Scacc.'"

The typical shells figured are without habitat. Whether the localities "Jamaica" and "Sicilian Tertiaries" really refer to the same specific form is open to question. Mr. A. H. Cooke reports *C. gadus* from the Gulf of Suez, dredged by Mac Andrew; and Melvill and Abercrombie include it in their Bombay list. It is evident that some of these localities are questionable; and the true habitat remains to be ascertained.

C. gadus has been identified by Sacco (Moll. Terr. Terz. Piem. e Ligur., xxii, 116) from the northern Italian Miocene; but his figure proves the identification incorrect.

Montagu gives the following description; and his figures are copied on my plate (fig. 27); the latter are characteristic, though the enlarged view is somewhat exaggerated.

"Dentalium with a subpellucid, subarcuated shell, tapering to a small point, pervious, contracting a little towards the larger end; is

white, glossy, and perfectly smooth, without the smallest appearance of wrinkles or striæ. Length scarce three-eighths of an inch ; diameter of the largest part, about one-sixteenth." (*Mont.*).

C. DIVÆ (Vélain). Pl. 26, figs. 82, 83.

Shell thin, white, transparent, elongated, moderately arcuated ; obviously swollen at the upper third ; surface smooth and glossy, showing some unequally spaced growth-striæ when sufficiently magnified. Anterior aperture perfectly circular, not oblique, contracted, with simple and sharp peristome ; posterior orifice quite large, simple, oblique, entire, without lobes or lateral slits. Length 4, diameter above ¾, below ½ mill. (*Vélain*).

Island of St. Paul, in the crater, 90 meters (French Transit of Venus Exped., 1874).

Gadus divœ [sic] CH. VELAIN, Arch. Zool. Expér. et Génér., vi, p. 128, pl. 5, f. 1, 2 (1877).

Apparently resembles *C. gadus*. We have not seen specimens.

C. MINUTUS H. Adams. Pl. 26, fig. 78.

Shell smooth, thin, arcuate, a little contracted anteriorly, whitish. Aperture circular, slightly oblique. Length 4, diam. ¾ mill. (*H. Ad.*).

Red Sea (MacAndrew).

Cadulus minutus H. AD., P. Z. S., 1872, p. 10, pl. 3, f. 9.—*Dentalium minutum* SOWERBY, Conch. Icon., xviii, pl. 7, f. 48 (1872).—COOKE, Ann. Mag. N. H. (5), xvi, p. 273 (1885).—CLESSIN, Conchyl. Cab., p. 18 (1896).

This may be a *Dischides*, but the apex has not been described.

Group of C. dentalinus.

Slender forms with the greatest girth situated very near the aperture, the constriction short and rather abrupt ; both apertures subcircular and simple ; surface smooth or circularly finely ribbed.

This group contains the most slender members of the genus *Cadulus*. The shell is considerably like that of *Ditrupa*, but less earthy and of more regular growth. The species are of two kinds : *circularly wrinkled* and *smooth*.

The sculptured series probably begins with *C. perpusillus* (Sowb.), imperfectly described in 1832, but this is not positively known, as the minute features of the surface of that species are still undescribed ; the next species in point of seniority is *C. dentalinus* (Guppy) of the

Jamaican Oligocene. This has modern descendants in *C. acus* of the Gulf of Mexico, and *C. panamensis* and var. *major* of the Panamic region. *It is extremely probable that all the above mentioned forms fall within the limits of one single species.* A smaller but allied species, *C. singaporensis*, occurs in the East Indian fauna.

The series of smooth species is also represented in the Antillean Oligocene. *C. elegantissimus* Pils. & Sharp and *C. phenax* P. & S. belong here. Recent, it has occurred only in the Californian fauna, where *C. aberrans* Whiteaves and the very closely allied *C. fusiformis* S. & P., and *C. hepburni* Dall, also similar, are found.

As to *C. dominguensis* (Orb.), its characters have been too indefinitely described to permit a positive location; and it is likewise doubtful whether *C. lævis* belongs to this group or some other; and it may even be non-molluscan. *Dentalium corrugatum* Cpr. is a young shell of the annulated *C. dentalinus* group.

Key to species.

I. Shell circularly corrugated toward the apex.
  a. More or less of a short inflation near the larger end; length 7–11 mill.; American forms.
    b. West American.
      c. Length 7·5 mill., 9 times the diam. (sculpture unknown), West Columbia, *perpusillus*, p. 190.
      c′. Length 7 mill., 7½–9 times the diam., Panama to L. Cal.. *panamensis*, p. 191.
      c″. Length 8–10 mill., 6–7¼ times the diam., *major*, p. 192.
    b. Antillean forms.
      c. Length 7–7·5 mill., 7¾–10½ times diam., Oligocene of Jamaica, *dentalinus*, p. 190.
      c′. Length 8 mill., 10½–11 times the diam.; recent, *acus*, p. 191.
  a′. Not inflated near larger end; less annulated; length 5·6 mill., 7¼ times the greatest diam.; Singapore, *singaporensis*, p. 195.

II. Shell smooth, not circularly corrugated.
  a. Length 28 mill., 14 times the diam. A doubtful member of the genus. N.-E., Australia, *lævis* p. 195.
  a′. Smaller and not nearly so slender; anterior constriction slight; West American.

b. Length 13·5 mill., 10 times the diam.,
aberrans, p. 193.

b'. Length 10·3 mill., about 9 times the diam.,
fusiformis, p. 193.

b''. Length 10 mill., about 7 times the diam.,
hepburni, p. 194.

C. dominguensis (p. 191) is not included in the above table.

C. PERPUSILLUS (G. B. Sowerby). (*Unfigured*).

Shell small, thin, narrow, curved, polished and white. Apex acute; aperture contracted, oblique. Length three-tenths, diam. one-thirtieth inch. (*G. B. S.*).

Puerto Salango, west coast of Colombia (Cuming).

Dentalium perpusillum G. B. SOWERBY, P. Z. S., 1832, p. 29.

"This is related to *D. gadus*, but is much more slender, and the aperture is obliquely truncated from the dorsal to the ventral margin." (*G. B. S.*).

In the Thes. Conch., iii, p. 104, this is referred to *Ditrupa*, not an unnatural conclusion. The shape and small size, length 7·5, diam. 0·83 mill., indicate, however, that it is a member of the *C. dentalinus* group of *Cadulus*, and perhaps identical with *C. panamensis*. Should this surmise prove correct, the name *perpusillus* will take precedence; and it is not unlikely that *C. dentalinus*, *acus* and *panamensis* may be ranked as mere varieties.

C. DENTALINUS (Guppy). Pl. 36, figs. 21, 22.

Shell acicular, very slender, abruptly swollen near the larger end; smaller half closely, circularly costulate.

Length 7, greatest diameter 0·9 mill.

Length 7·5, greatest diameter 0·71 mill.

Jamaica, an Oligocene fossil.

Ditrupa dentalina GUPPY, Geological Magazine, (n. ser.) decade II, Vol. I, 1874, p. 445, pl. 16, f. 11 (bad, no description).—*Ditrupa dentalinum* GUPPY, Geol. Mag., 1875, p. 42.

Outline figures drawn from author's examples of this Jamaican Oligocene species are here given for comparison with the following recent forms, which we hesitate to separate as species. There is considerable variation in proportions, a slender and a stouter shell being figured. The annulation is similar to that of *C. panamensis* and *C. acus*, *q. v.*

C. ACUS Dall. Pl. 36, fig. 27.

Shell small, very slender, slightly curved, variegated with translucent and opaque white rings and encircling bands, which become broader toward the anterior extreme; aperture circular, slightly oblique, the shell behind it rapidly increasing to its point of maximum diameter, from which it very gradually tapers toward the almost acute posterior extremity. Surface smooth, with extremely fine circular grooves or lines, which under a strong magnifier are visible over most of the posterior third of the shell, with their interspaces, recalling the rings of *Cœcum trachea* on a much more minute scale; the rings of opaque color sometimes coincide with the sculpture, but not constantly. Length of shell 8·0, diameter of aperture 0·5, greatest diam. 0·75, posterior diam. 0·12 mill. (*Dall*).

Samana Bay, S. Domingo, in 30 fms. (Capt. Couthouy, U. S. N.).

Cadulus acus DALL, Bull. M. C. Z., xviii, Blake Rep., p. 432, pl. 27, f. 11 (1889); Bull. U. S. Nat. Mus., No. 37, p. 78, pl. 27, f. 11.

Very closely allied to *C. dentalinus* Guppy of the Jamaican Oligocene or Miocene, and possibly also to *C. dominguensis* d'Orb.

C. DOMINGUENSIS (Orbigny). Pl. 36, fig. 26.

Shell lengthened, narrow, arcuate, smooth and shining; apex acuminate. Length 7 mill. (*Orb.*).

San Domingo, Martinique and Cuba, on the sand (Orb.).

Dentalium dominguense D'ORB., ("1846"), Hist. etc., d'Ile de Cuba (de la Sagra), Moll., ii, p. 201 (1853); Atlas, pl. 25, f. 7, 8, 9.

This little species is easily recognized by the contraction of the aperture, which is oblique and oval. (*Orb.*).

It is known only by d'Orbigny's description and figures. Type was deposited in British Museum (Catal., p. 34).

C. PANAMENSIS Sharp & Pilsbry, n. sp. or var. Pl. 36, figs. 23, 24 25.

Shell *very slender, acicular*, quite arcuate, the bend mainly posterior; *encircled quite near the aperture by a convexity or swollen band*, from which it contracts rapidly to the aperture, and posteriorly tapers gradually to the small apex; circular in section. Bluish-white, a little translucent, the anterior swelling opaque white. *Surface closely and finely sculptured with encircling wrinkles or riblets* from the apex nearly to the middle, the remainder smooth except for light growth-lines, shining. Aperture circular, somewhat oblique; apical orifice circular with unslit edges.

Length 7, diam. at aperture 0·625, at greatest bulging 0·934, at apex 0·25 mill.

Length 7, diam. at aperture 0·5, at greatest ·75, at apex 0·2 mill.

Panama Bay, in 26 and 51 fms., mud; *off Guaymas, Mexico*, in 20 fms.; *in the Pacific off Lower California, 'Albatross' Sta. 2,830, lat. 23° 33′, long. 110° 37′*, in 66 fms.; *near Cerros Id.*, 26 fms. (U. S. Fish Commission); *Mazatlan* (Cpr.).

Dentalium corrugatum Cpr., Cat. Mazatlan Shells, p. 189 (1857), a very young shell. Not *D. corrugatum* Gay, 1854.

This species is extremely similar to *C. dentalinus* (Guppy) from the Jamaican Oligocene, but the concentric wrinkles are perceptibly more crowded and less oblique in the living than in the fossil form. Compared with the Antillean *C. acus* Dall, our species or variety is decidedly stouter and more curved, with stronger constriction at the mouth.

Types, No. 122,795 U. S. Nat. Mus.

The shells from off Guaymas and Cerros Island are the size of the types, but more annulated.

Var. *major* P. & S. Pl. 36, figs. 28, 29, 30.

A larger form of this species occurs off Lower California at Station 2,830 of the Fish Commission, in 66 fms. sand. The larger specimens are annulated for a shorter distance from the apex than in the Bay of Panama types. Three specimens (illustrated) measure:

Fig. 28, length 10·37, diam. at aperture 1·12, at greatest 1·72, at apex 0·75 mill.

Fig. 29, length 8·62, diam. at aperture 1·0, at greatest 1·37, at apex 0·37 mill.

Fig. 30, length 8·12, diam. at aperture 0·87, at greatest 1·12, at apex 0·44 mill.

The specimens of this form are No. 96,570, U. S. Nat. Mus.

The dimensions of Carpenter's *Dentalium corrugatum*, length 1·25, greatest diam. 0·25, apical diam. 0·125 mill., indicate, as Carpenter says, a very young specimen. One only was found; the concentrically wrinkled surface being its most remarkable character. We have little doubt that it is the very young of *Cadulus panamensis*, which is also annulated; but in any case the name is preoccupied for a Chilian Tertiary species of the group of *D. ceras*, and will, therefore, be dropped. Carpenter's description here follows:

"*D. corrugatum.* Shell whitish-corneous, subdiaphanous, little arcuate, slender. Surface concentrically, irregularly corrugated,

the wrinkles small and very close. Branchial aperture simple. Length 0·05, breath 0·005–0·01 inch." (*Cpr.*).

Mazatlan, on Spondylus calcifer.

C. ABERRANS Whiteaves. Pl. 35, fig. 16.

Shell slender, moderately but distinctly curved, large and much elongated for the genus, increasing very slowly but regularly in diameter, not distinctly (if at all) swollen in advance of the middle, and very slightly and scarcely perceptibly constricted immediately behind the aperture. Test extremely thin, surface polished, very glossy and shining, smooth to the naked eye, but under a lens it is seen to be marked with minute and transverse but somewhat oblique lines of growth (*Whiteaves*).

Length of an average full-sized example 13·5 mill., greatest breadth of the same near the anterior end 1·3 mill. (*Whiteaves*).

Quatsino Sound, British Columbia, abundant (Whiteaves).

Cadulus aberrans WHITEAVES, Trans. Roy. Soc. Canada, iv, Sect. 4, p. 124, f. 2 (1887).—TAYLOR, Ibid. (ser. 2), i, Sect. 4, p. 56.

This little shell, which is, nevertheless, of large size for the genus, looks not unlike an immature *Dentalium*, and, at first sight, specimens of it might be easily mistaken for half-grown examples of *D. pretiosum* Nuttall, which the Indians say occurs at the same locality. It may, however, be distinguished from any *Dentalium* by its thin test and highly polished outer surface, though the swelling of the shell in advance of the middle and the constriction behind the aperture which are usually marked characters in the genus *Cadulus*, are reduced to a minimum in this species, and in most specimens are quite imperceptible (*Whiteaves*).

C. FUSIFORMIS Pilsbry & Sharp, n. sp. Pl. 35, fig. 14.

Shell but little curved, long and slender, the greatest diameter contained about 9 times in the length of the shell; swelling hardly perceptible, the tube very gradually enlarging from the small apex to the beginning of the last third of the length, thence an equal size is maintained almost to the aperture, just before which it is gently but quite perceptibly contracted on all sides. Surface smooth and glossy, bluish-white, scarcely translucent, with oblique rings of more opaque white, and near the apex some longitudinal white lines; a pellucid ring bordering the lip-edge, behind which there is a short, opaque white tract, passing gradually into the bluish and banded general color. Tube a mere trifle compressed vertically at the

widest part. Aperture oblique, and (measured obliquely) a trifle longer than wide (in the ratio of 35 : 33); lip thin, sharp. Anal orifice circular and simple.

Length 10·37 mill.; antero-posterior diameter at aperture 1·0, at widest 1·14, at apex 0·37 mill.; greatest transverse diameter 1·17 mill.

San Pedro, California (J. G. Cooper); *fossil in well at San Diego, Cal.*, at 150 ft. depth (Hemphill).

C. fusiformis " Phil.," Cooper in U. S. National Museum, and Hemphill in collection Acad. Nat. Sci. Phila.

Closely allied to *C. hepburni* Dall and *C. aberrans* Whiteaves; but it is decidedly slenderer than the first, and less curved than the other of these species. The type is a specimen collected alive, No. 133,809, U. S. Nat. Mus.; other and fossil specimens from a San Diego well (Pliocene) have been collected by Henry Hemphill. The specific name " fusiformis Phil." seems to have obtained currency on the West Coast, but we have been unable to find it in Philippi's writings, or, in fact, in any printed work. There is also a dead shell, perhaps Pliocene, in the U. S. Nat. Mus., with the name "*C. intentior* Cpr.," identical with this species.

C. hepburni Dall. Pl. 35, figs. 19, 20.

Shell slightly arcuate, the latter half nearly straight, narrow, the greatest diameter contained about 7 times in the length of the shell; calibre gradually increasing from the apex to within about a millimeter of the aperture, then quite perceptibly contracting. A trifle compressed between the concave and convex sides. Surface polished, smooth, white. Apertures subcircular, their margins simple.

Length 10 mill.; antero-posterior diam. at aperture 1·11, at greatest 1·33, at apex 0·45 mill.; lateral diam. at aperture 1·23, at greatest 1·4, at apex 0·5 mill.

Type measures: length of shell, 11; diameter at anterior end, 1·25; at posterior end, 0·75 mill.

Near Victoria, Vancouver Island, in 60 fms. (Nat. Hist. Soc. of British Columbia).

Cadulus hepburni Dall, Nat. Hist. Soc. Brit. Columbia, Bull. No. 2, p. 12, pl. 1, f. 13 (1897).

The contraction toward the aperture is very slight, and mainly confined to the covex side. The surface is eroded near the apex in all the specimens collected, so the measurements of apex are approxi-

mate. While quite slender, it is still somewhat stouter than *C. aberrans;* and *C. fusiformis* is less curved and less constricted at the aperture. Our description and figures of this species and *C. tolmiei* are from part of the original specimens, kindly transmitted by Dr. C. F. Newcombe. Dall writes:—

"This shell, in some lights, appears to have longitudinal streaks of more or less opaque white, but there is no development of longitudinal sculpture.

"The only other species described from this region is *Cadulus aberrans* Whiteaves, which is larger and more arcuate. An apparently undescribed species from the east coast of North America, near Cape Hatteras, North Carolina, is very close to *C. hepburni,* though the slight differences observable may be thought sufficient, taking the habitat into consideration, to separate it specifically. I have named the Columbian species in honor of the late James Hepburn, Esq., one of the earliest collectors of British Columbian mollusks, and who is well known for his contributions to the herbaria of European botanists."

C. SINGAPORENSIS Sharp & Pilsbry, n. sp. Pl. 36, figs. 30, 31.

Shell small, very slender, closely striated obliquely with alternate white and translucent bands, smooth and glossy on the larger part, *encircled by low, close wrinkles near the apex.* Gradually increasing from the apex to quite near the aperture, then contracting moderately on all sides; equator or point of greatest diameter, at about the anterior ninth of the shell's length, the diameter there contained about 7⅓ times in the length. Tube faintly compressed vertically throughout. Aperture not oblique, subcircular; anal orifice simple.

Length 5·6 mill.; diam. at aperture 0·56 x 0·6, at greatest 0·75 x 0·77, at apex 0·29 x 0·34 mill. (the antero-posterior dimensions in each case given first).

Singapore (Dr. S. Archer).

Allied to *C. dentalinus* and its recent varieties *panamensis* and *acus,* but smaller, less distinctly and for a shorter distance annulated, not swollen near the larger end, etc. It is a very much smaller shell than either *C. hepburni, C. aberrans* or *C. fusiformis.*

C. (??) LÆVIS (Brazier).

Shell light amber-color, sometimes white, smooth, glossy, strongly arched, half-moon shaped, basal margin pinched in about two lines long, forming somewhat like a shoulder, then slightly ventricose,

from that to the apex regularly tapering, apex with a minute perforation entire. Length, 14 lines; diam. of base at shoulder, 1; below, ½ line [28, 2, 1 mill.] (*Brazier*).

Princess Charlotte Bay, northeast Australia, 13 fathoms, sandy mud; *Cape Grenville, northeast Australia*, 20 fathoms, mud; *York Island, Torres Straits*, 13 fathoms, hard mud bottom; *Darnley Island, Torres Straits*, 5, 15, 20, 30 fathoms (Chevert Exped.).

Dentalium lævе BRAZIER, Proc. Linn. Soc. N. S. Wales, ii, p. 59 (1877). Not *D. lævе* Schlotheim.

The lower part of this species resembles the spines of the sea-urchins (Echinidæ). The greater part of the specimens are encrusted over with a fine coating of coral-like substance (*Braz.*).

Described as a *Dentalium*, the specific name being preoccupied. It seems to be a *Cadulus* or a *Ditrupa*. We have not seen specimens, but the last clause of Brazier's observations suggests the latter genus.

Appendix A. Fossil Scaphopoda.

The references given below comprise the original description of each species, usually with some of the most useful subsequent references. It has not been considered advisable to cite the full literature of each species. The synonymy, while partly original, has been, in large measure, adopted from various specialists upon molluscan fossils of the several formations.

Genus DENTALIUM L.

I. CENOZOIC OR TERTIARY SPECIES.

(Recent species extending into the Pliocene are generally omitted from the following list).

D. ABSCONDITUM Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 212–213, pl. 1, figs. 15–17.

Eocene, Paris Basin.

D. ACRE Sharp & Pilsbry, 1898. New name for *D. acicula* Deshayes 1864, not Gld. 1859.

D. acicula DESHAYES, 1864 (not of Gould, 1859), Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 202–203, pl. 1, figs. 31–32.

Eocene, Paris Basin.

D. ACRICULUM (Tate), 1887.

Entalis acriculum TATE, 1887. Trans. & Proc. R. Soc. S. Australia, Vol. ix, p. 192, pl. xx, fig. 11.

Eocene, Lower beds of Muddy Creek, Victoria, Australia.

D. ACUTICOSTA Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, ii, p. 357, pl. xviii, fig. 3.

Eocene, Paris Basin.

D. ACUTUM Hébert, 1849. Bull. Soc. Geol. France, 2, Vol. vi, p. 469. Not of Deshayes, Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 205, pl. 20, figs. 1–3.

D. grande NYST, 1836, not of Deshayes. Rech. Coq. foss. de Hoesselt et Kl., p. 39, No. 103.

D. nystii D'ORBIGNY, 1852 (proposed for *D. grande* Nyst, 1843, not of Deshayes, 1825); Prodr. Paléont. Strat., Vol. iii, p. 18, No. 277.

Entalis cf. *acuta?* Héb. var. *apenninica* SACCO. Moll. Terr. Terz. Piem., xxii, p. 106. (Probably belongs elsewhere).

Eocene, Mayence Basin, etc.

D. AEQUALE Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p, 204, pl. 20, figs. 5–7.

Eocene, Paris Basin.

D. AGILE var. OLEACINUM Dall, 1892. Trans. Wagner Free Inst. Sci., Vol. iii, p. 441.

Pliocene of the Caloosahatchie, Florida.

D. ALTERNANS Chenu, 1842, ("Museum de Paris"). Illustr. Conch., Vol. i, p. 1, pl. 4, fig. 17.

Probably Tertiary; locality unknown (*Dentalium s. str.* group of *D. octangulatum*).

D. ANCEPS Sowerby, 1837. Trans. Geol. Soc. London (2d Ser.), Vol. v, p. 136, pl. viii, fig. 19.

Fustiaria anceps R. B. NEWTON, Syst. List Edwards Coll., p. 284.

Entaliopsis anceps NEWTON & HARRIS, Proc. Malac. Soc. Lond., i, p. 66.

Eocene, London Clay.

D. ANGUSTUM Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 210–211, pl. 1, figs. 1–3.

D. striatum J. Sowerby, 1814. Min. Conch., i, p. 160, pl. 70, f. 4.

D. (Entalis) striatum COSSMANN, Ann. Soc. R. Malac. Belg., Vol. xxiii, p. 8.

Fustiaria striata NEWTON, 1891. Brit. Oligocene & Eocene Moll., p. 286.

Entaliopsis striata NEWTON & HARRIS, 1894. Proc. Malac. Soc. London, Vol. i, p. 68.

D. costatum J. de C. Sowb., 1850, in Dixon, Geol. of Sussex, p. 96, pl. vii, fig. 2. Not *D. costatum* J. Sowb., 1814.

D. striatum Brander, 1775. Foss. Hantoniensia coll. et Mus. Brit. depos., pl. 1, fig. 10. So quoted by Deshayes in Descr. Anim. s. Vert. Paris Bassin, Vol. ii, p. 206. In Brander's work of this title, published in 1766, the same figure is called *D. elephantinum.* Deshayes may quote from another edition which we have not seen. See also Sowerby, Min. Conch. (1814), Vol. i, p. 160, pl. 70, f. 4.

Eocene, Paris Basin and the Barton Beds of England.

D. ANNULATUM Meyer, 1886. Geol. Surv. Alabama, Bull. No. 1 (2), p. 64, pl. 1, f. 1. (Not *D. annulatum* Gmelin).

Eocene: Claiborne, Alabama.

Considered by Dall a form of *D. minutistriatum* Gabb.

D. ANNULATUM Gmelin, 1788. Syst. Nat. (13), p. 3,738, No. 15. We have not access to Guettards work in which this is figured, and are, therefore, ignorant of its characters and geological horizon. Sacco refers it with doubt to *D. jani* Hörnes, *q v.*

D. ARATUM Tate, 1887. Trans. & Proc. Roy. Soc. S. Australia, Vol. ix, p. 192, pl. xx, fig. 8.

Eocene, Victoria, Australia.

D. ARAUCANUM Philippi, 1887. Tertiär. und Quartär. Verstein. Chiles, p. 107, pl. xii, fig. 17.

Tertiary of Chili.

D. ARCIFORME Conrad, 1846.

D. arciformis CONRAD, Amer. Jour. Sci. (2 Ser.), Vol. i, p. 212, pl. 1, fig. 3.

D. leai MEYER, 1885. Amer. Jour. Sci., Vol. 29, p. 462; figured in Geol. Surv. of Alabama, Bull. No. 1, (2), pl. 1, figs. 2, 2a.

Eocene, Alabama.

D. ATTENUATUM Say, 1824. Journal Acad. Nat. Sci. Phila., Vol. iv, p. 154, pl. 8, fig. 3.

D. dentale CONRAD, 1840. Fossils of the Medial Tertiary of the U. S., No. 2, p. 78, pl. 44, fig. 9.

D. duodecenaria CONRAD, 1862. Proc. Acad. Nat. Sci. Phila., p. 570.

Chesapeake Miocene, from Maryland to South Carolina; Alum Bluff, Fla.

D. AUSTRALIS Sharp & Pilsbry, 1898. New name for *Entalis annulatum* Tate, 1887, preoc. by Gmelin and by Meyer.

Entalis annulatum TATE, 1887. Trans. & Proc. R. Soc. S. Australia, Vol. ix, p. 191–2, pl. xx, fig. 6a, b.

Earlier Tertiary, Muddy Creek, S. Australia.

D. BADENSE Partsch, 1856, in Hoernes, Abhandl. K. K. Geol. Reichs. Anst. Wien, p. 652, pl. 50, fig. 30.—*Entalis badensis* SACCO, Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 107, pl. 9, f. 17–20, with var. *pliocenica, laticostata, pseudobouei, paucicostata, planicostata* of Sacco.

D. rectum Gmel. var., of BONELLI, SISMONDA and some others.

Lower Miocene: Aquitanian, Elvezian, etc., of South Germany and Austria and northern Italy.

D. BIFRONS Tate, 1887. Trans. & Proc. Roy. Soc. South Australia, Vol. ix, p. 192–3, pl. xx, fig. 5.

Miocene, upper beds at Muddy Creek, Victoria, Australia.

FUSTIARIA BISIPHONATA "Edwards" in NEWTON, 1891. Brit. Oligocene & Eocene Moll., p. 284.

Lower Eocene, London Clay, at Haverstock Hill, England.

Not described, and as the species is not mentioned by Newton & Harris in their later revision of British Eocene Scaphopods, it is probably either not valid or based on material unsuitable for characterization.

D. BITUBATUM Meyer, 1886. Alabama Geol. Surv., Bull. No. 1 (2), p. 64, pl. 3, fig. 1.

Eocene, Jackson, Mississippi.

D. BLANDUM De Gregorio, 1890. Ann. Geol. et Palaeont., 8 livr., p. 172, pl. 17, figs. 26–31.

Eocene, Claiborne, Alabama.

D. BOUEI Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, ii, p. 355, pl. 18, fig. 8.—*Antale bouei* SACCO, Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 98, pl. 8, f. 6–12, with var. *tauraspera*, *perlævis* and *taurogracilis* Sacco.

D. intermedium HOERNES, Fauna Schliers v. Ottnang, p. 32 (part).

D. borcei MICHELOTTI, Etudes Mioc. Inf. Ital., p. 136, 1861.

Oligocene, northern Italy and Austria.

D. BREVE Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 201–202, pl. 1, figs. 7–8.

Entaliopsis brevis NEWTON & HARRIS, Proc. Mal. Soc. Lond., i, p. 67.

Fustiaria brevis NEWTON, 1891. Brit. Oligocene & Eocene Moll., p. 284.

Eocene, Paris Basin; Thanet Sands, England.

D. BREVIFISSUM Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 366, pl. xvii, figs. 13–14.

D. brevissimum ANTON, 1839. A misspelling for *D. brevifissum* Deshayes, 1825. Anton, Verzeich. Conch., p. 25.

Near Anger, France.

D. BRONGNIARTI Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 212, pl. 2, figs. 20–21.

Eocene, Paris Basin.

D. BURDIGALINUM Mayer, 1864. Journ. de Conch. (3), Vol. iv, p. 357, pl. xiv, fig. 4.

Miocene, Bordeaux.

D. BUTINI Nyst, 1854. Encycl. Pop. Geol., p. 382. New name for *D. brevifissum* Galeotti, 1837, not of Deshayes, 1825.

This is taken from the MS. card catalogue of Deshayes; we have not seen the work.

D. brevifissum GALEOTTI, 1837. Mem. Const. Geol. de Brabant, p. 150.

Tertiary of Belgium.

D. CADULOIDE Dall, 1892. Trans. Wagner Free Inst., Vol. iii, p. 442, pl. 23, fig. 25.

Miocene of Maryland.

D. CALABRUM Costa, 1851. Fauna Reg. Napoli, Dent., p. 35, pl. iii, fig. 4.

? Pliocene, Calabria.

D. CALLIOGLYPTUM Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 468, pl. 10, f. 10, 12; pl. 11, f. 21.

Oligocene of San Domingo.

D. CALOOSAENSE Dall, 1892. Trans. Wagner Free Inst., Vol. iii, p. 441, pl. 23, fig. 24.

Pliocene of the Caloosahatchie, Florida.

D. CANALICULATUM Klipstein, 1843. Beitr. Geol. Kennt. Oestl. Alpen., p. 206, pl. 14, fig. 28.

We have not seen this publication, and the exact locality and geological horizon of the species is unknown to us.

D. CAROLINENSE Conrad, 1862. Proc. Acad. Nat. Sci. Phila., pp. 288 and 570 (1863).

Chesapeake Miocene of North Carolina, James River, Va., Alum Bluff, Fla.

D. CASTELLANENSE d'Orbigny, 1850.

D. castellanensis D'ORBIGNY, 1850, Prodr. Paléont. Strat., Vol. ii, p. 320, No. 430.

Tertiary at Le Vit, Basses Alpes, France.

D. CIRCINATUM Sowerby, 1823. Genera of Shells, *Dentalium*, fig. 5.—DESHAYES, Descr. An. s. Vert., ii, p. 216, pl. 2, f. 8–10.—COSSMANN, Ann. Soc. R. Mal. Belg., xxiii, p. 10.

Eocene of the Paris Basin.

D. COCENTUM Hoeninghaus, 1831. Jahrb. Min. Geol., p. 155, *nomen nudum.*

Tertiary, Tabbiano.

D. CONICUM Hutton, 1873. Cat. Tertiary Moll. New Zealand, p. 1; figured in the Macleay Mem. Volume, 1893, p. 73, pl. viii, fig. 77.

Pliocene of New Zealand.

D. CONSTRICTUM Newton & Harris, 1894. Proc. Malac. Soc. London, Vol. i, pt. 2, p. 64, fig. in text.

Eocene: London Clay, Fareham and Portsmouth, England.

D. COSSMANNIANUM Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 467, pl. 10, f. 11; pl. 11, f. 10, 11.

Oligocene of San Domingo.

D. COSTÆ Deshayes, 1898. New name for *D. lacteum* Costa, 1850, not of Deshayes.

D. lacteum COSTA, 1850. Faun. Reg. Napoli, Tubibranchi, p. 37, pl. 3, fig. 7.

Italian Pliocene, Amato, Gravina, etc.

D. COSTATUM Sowerby, 1814. Mineral Conchology, Vol. i, 1814, pl. 70, fig. 8. See also NYST, Ann. Mus. Roy. d'Hist. Nat. Belg., iii, pt. i, p. 121, pl. 7, f. 15 (1881).

Pliocene: Coralline and Red Crag, Sutton, etc., England; Yellow Scaldisien, Antwerp, Belgium.

D. DANAI Meyer, 1885. Am. Journ. Sci., Vol. xxix, p. 462; figured in Alabama Geol. Surv. Bull. No. 1 (2), 1886, pl. 3, figs. 2–2a.

Eocene: Jackson, Mississippi.

D. DEFRANCII Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 211, pl. 2, figs. 14–16.

Eocene of the Paris Basin.

D. DELPHINENSE Font. Cf. Sacco, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 95.

D. DENSMURIS Mayer, 1858. Journ. de Conch. (2), Vol. iii, p. 79, pl. iv, fig. 3.

Miocene, St.-Jean de-Marsacq, near Dax.

D. DESHAYESI Risso, 1826. Hist. Nat. Europ. Mérid., Vol. iv, p. 400.

A Pliocene or Miocene species described from "la Trinite et Saint-Jean." Has not been recognized by later paleontologists.

D. DISCREPANS Risso, 1826. Hist. Nat. Europ. Merid., Vol. i, p. 125. *Nomen nudum.*

D. DISSIMILE Guppy, Quart. Journ. Geol. Soc., xxii, p. 292, pl. 17, f. 4 (1866).—PILSBRY & SHARP, Proc. Acad. Nat. Sci. Phila., 1897, p. 469, pl. 11, f. 3–5.

Oligocene, Bowden, Jamaica.

D. DISSIMILE var. PONDEROSUM Gabb, 1873. PILSBRY & SHARP, t. c. p. 470, pl. x, figs. 1, 2, 3; pl. xi, figs. 15, 16.

D. ponderosum GABB, Trans. Amer. Philos. Soc. (N. Ser.), xv, p. 244.

Oligocene of San Domingo.

D. DOLLFUSI Koenen, 1883. Neues Jahrb. Min. & Geol., Beilage-Band, ii, p. 326.

Miocene of North Germany, etc.

Proposed as a new name for *D. costatum* Nyst in Dewalque, Prodrome d'une Descript. Géol. Belgique, p. 425; 2d edition, 1880, p. 483,

Koenen states that this is not the *costatum* of Sowerby; but it is doubtful whether he had the real *costatum* of Nyst. The species *dollfusi* rests therefore upon Koenen's description only.

D. DUFRESNII Deshayes, 1825, Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 361, pl. xvii, fig. 18.

Pliocene? "Marcigny en Borgogne," France.

D. DUPLEX Defrance, 1819. Dict. Sci. Nat., Vol. xiii, p. 71. Figured in Deshayes, Descr. Anim. s. Vert. Bassin Paris, Vol. ii, pl. 1, figs. 36–39.

D. bicarinatum DESHAYES, 1826. Mem. Soc. Hist. Nat. Paris, Vol. ii, p. 364, pl. xviii, figs. 16–17.

Eocene of Paris Basin.

Type of the section *Lobantale* Cossmann.

D. ENTALIOPSIS Sharp & Pilsbry, n. n.

Entaliopsis annulata NEWTON & HARRIS, Proc. Malac. Soc. Lond., i, p. 67, pl. 6, f. 1. Not *D. annulatum* Gmel., or Meyer, nor *Entalis annulata* Tate.

Eocene, London Clay, Portsmouth, etc.

D. ENTALOIDES Fleming, 1825. Edinburgh Phil. Jnl., Vol. xii, p. 240. New name for *D. entalis?* Sowb., Min. Conch., i, pl. 70, f. 3.

Hordwell Cliffs and Stubbington, England.

See Searles Wood, Crag Moll., i, p. 189, who considers the specimens of doubtful identity, probably having lost the outer coat.

D. EUGENII Dall, 1892. Trans. Wagner Free Inst. Sci., Vol. iii, p. 438, 442.

Eocene, Prairie Creek, Ala.

D. EXLAMARCKI (Sacco), 1897.

Entalis exlamarcki SACC., new name for *D. lamarcki* Mayer, 1864, not of Chenu.

D. lamarcki MAYER, 1864, Journ. de Conch. (3), IV, p. 357, pl. xiv, fig. 5, No. 102.

Piacenzian Pliocene of Castelnuovo-d'Asti.

D. FISSURA Lamarck, 1818. Anim. s. Vert., Vol. v, p. 346; figured in Desh., Descr. Anim. s. Vert. Bassin Paris, ii, pl. i, figs. 24–25, 26.

D. nitens J. DE C. SOWERBY, Dixon's "Sussex," 1850, p. 95, pl. 7, f. 3 (not of J. Sowerby, 1814).

Fustiaria fissura NEWTON & HARRIS, Proc. Malac. Soc. Lond., i, p. 64.

Eocene, Paris Basin and Bracklesham Beds, England.

D. FOSSILE Gmelin, 1788. Syst. Nat. (13), p. 3,738.—*Antale fossile* SACCO, Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 99, pl. 8, f. 22–30, with var. *raricostata* Sacc.

D. catenulatum CHENU, 1842. Illustr. Conch., Vol. i, p. 2, pl. 4, fig. 11. A discolored *D. fossile* Gmelin.

Tortonian Upper Miocene, to Astian Upper Pliocene, Piedmont.

D. FRITSCHI v. Koenen.

A European Oligocene species, of which we have not seen the description. It is considered by Sacco a probable ancestor of *D. rubescens.*

D. FUNICULUS Brugnone, 1877. Bull. della Societa Malacologica Italiana, iii, p. 44, pl. 1, f. 5.

Pliocene, Ficarazzi, Italy.

Probably a synonym of *D. filum* Sowerby, notwithstanding the slight differences indicated by Brugnone.

D. GABBI Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 470, pl. 10, f. 6, 7, 13; pl. 11, f. 1, 2.

D. affine GABB, Trans. Amer. Philos. Soc. (N. Ser.), xv, p. 244 (1873). Not *D. affine* Deshayes, 1864, nor of Biondi, 1859.

Oligocene of San Domingo.

D. GAYI Philippi, 1887. Tertiär. und Quartär. Verstein. Chiles, p. 107, pl. xii, fig. 19.

Tertiary of Chili.

D. GEMINATUM Goldfuss, 1844. Petref. Germ. pt. 3, p. 4, pl. 166, f. 13.—SPEYER. Paleontographica, xvi, p. 29, pl. 2, f. 9–11.

Upper Oligocene, Göttentrup; Doberges bei Bünde.

D. GERMANICUM Chenu, 1842. Illustr. Conchyliologiques, i, pl. 5, f. 15a, b. No description. Evidently a European Tertiary species.

D. GNIZUM De Gregorio, 1890. Ann. Geol. et Palaeont., 8 livr., p. 173, pl. 17, figs. 42–43.

Eocene, Claiborne, Alabama.

Probably a young *Cadulus*. Unrecognizable.

D. GRANDE Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 365, pl. xvii, figs. 1, 2, 3; Descr. An. s. Vert. Bassin Paris, ii, p. 205, pl. 2, f. 1–4, 23–26.

Fustiaria grandis NEWTON, 1891. Brit. Oligocene & Eocene Moll., p. 285.

Entaliopsis grandis NEWTON & HARRIS, 1894. Proc. Malacol. Soc. London, Vol. i, p. 67–68.

Eocene, Paris Basin; England.

D. GUIDOTTII Sacco, 1897. Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 95. New name for *D. deshayesii* Guid., 1873; not of Risso, 1826.

D. deshayesii GUIDOTTI in Cocconi, Mem. Acad. Sci. Bologna (3), Vol. iii, p. 644–645, pl. vi, fig. 17–17′.

Piacenzian Pliocene of Rivalta nel Piacentina, Italy.

D. HAERINGENSE Dreger, 1892. Ann. K. K. Naturhist. Hofmuseums Wien, Vol. vii, p. 12, pl. i, figs. 2 a–b.

Pliocene? Bavaria.

D. HANNONICUM Briart & Cornet, 1889. Mém. Acad. Roy de Belgique, Vol. 67, p. 81.

Upper Eocene of Mons.

D. HAYTENSE Gabb, 1873. PILSBRY & SHARP, Proc. Acad. Nat. Sci. Phila., 1897, p. 471, pl. xi, figs. 8–9.

D. haytensis GABB, Trans. Amer. Philos. Soc. (N. Ser.), XV, p. 244.

Oligocene of San Domingo.

D. INÆQUALE Bronn, 1831. Italien's Tertiär. Gebild., p. 84.—SACCO Moll. Terr. Terz. Piemonte, pt. 22, p. 95, f. 70-73, with var. *rotundatior* Sacco.

D. orsum Bonelli, in SISMONDA, Syn. Meth., edit. 1, p. 25.

Upper Miocene (Tortonian) of Piedmont and Liguria, Italy.

D. INÆQUICOSTA Seguenza, 1880. Real. Acad. Lincei, An. 1879–80, Form. Terz. Prov. Reggio (Calabria), p. 117, pl. xi, fig. 48, 48a.

Miocene, Tortonian stage, Italy.

D. INCERTULUM (Sacco), 1897.

Fustiaria incertula SACC., Moll. Terr. Terz. Piem. e Ligur., xxii, p. 113, pl. 10, f. 34.

D. intermedium COPPI, Framm. di Paleont. Modense, p. 16, Boll. R. Comitato Geol. Ital.. vii, p. 203, 1876, not of Gay, 1854.

Upper Miocene, Tortonian and Piacenzian, S. Agata and Montegibbio, N. Italy.

D. INCERTUM Deshayes, 1826. Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 362–363, pl. xvii, fig. 17; Descr. An. s. Vert. Bassin Paris, ii, p. 202, pl. 1, f. 26, 27.

Eocene of the Paris Basin.

D. INCISISSIMUM Meyer & Aldrich, 1886. Journ. Cincinnati Soc. Nat. Hist., Vol. ix, p. 40, pl. 2, fig. 1.

Eocene (Oligocene) Wautubbee, Mississippi.

D. INCISUM Chenu, 1842. Illustr. Conch., Vol. i, p. 4, pl. 6, figs. 8–9.

Described from Italy, without more exact locality. It is probably pliocene, and is not unlike *D. agile.*

D. INOPINATUM Mayer.

A European Eocene species allied to *D. sexangulum*, of which we have seen no description.

D. INTERMEDIUM Hupé, in Gay, 1854. Hist. Chile, viii, p. 276, Atlas, Zool., pl. 2, fig. 9.

Tertiary, coast of Topocaima, Chili.

D. INTERRUPTUM Gmelin, 1789. Syst. Nat. (13), p. 3,739.—*Entalis interrupta* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 108, pl. 9, f. 36–46.

Tortonian upper Miocene, S. Agata, Stozzano, Montegibbio, northern Italy.

D. IRREGULARIS Risso, 1826. Hist. Nat. Europ. Mérid., Vol. iv, p. 400.

Probably Pliocene or Miocene, at "Trinité." Not recognized thus far by other authors.

D. JANI Hörnes, 1856. Foss. Moll. Tertiär Beckens Wien, p. 657, pl. 50, f. 37.—QUENSTEDT, Petrefactenkunde, vii, p. 807, pl. 217, f. 84, 85.—*Fustiaria jani* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 112, pl. 10, f. 25–33 with var. *striatellulata* Sacc.

Miocene and Pliocene, Tortonian to Astian, Northern Italy and Austria.

D. KICKXII Nyst, 1843. Bull. Geol. Soc. France, Vol. xiv, p. 454; figured in Descr. Coq. et Polyp. foss. Tert. Belgique, pl. xxxvi, fig. 1.

D. *acuticosta* KONINCK, 1837. Not of Deshayes. Mém. Roy. Acad. Belg., Vol. xi, p. 29, No. 50. We have not seen this work and take the quotation from Nyst (below).

D. acuticosta NYST, 1835. Not of Deshayes, 1825. Recher. Coq. foss. prov. Anvers, p. 36.

D. fossile PHILIPPI, 1846, not of Gmel. Verz. Gegend Magdeburg. Tert. Verstein., Palæontograph, Vol. i, p. 80.

Eocene of Belgium, Magdeburg, Paris Basin.

D. KŒNIGIANUM Risso, 1826. Hist. Nat. Europ. Merid., Vol. i, p. 125.—*Nomen nudum.*

D. LÆVE Hilgard & Hopkins, 1878 (not of Schlotheim, 1820). Report Borings, Mississippi River and Lake Borgne (Engineer Depart. U. S. Army), p. 48, pl. iii, fig. 6.

Post Pliocene, borings for the Lake Borgne outlet, Lousiana.

Based upon young shells and fragments, probably referable to *D. filum* Sowerby (p. 118) of the recent and Pliocene faunas.

D. LÆVIGATUM Eichwald,1830. Nat. Hist. Skizze von Lithuanen, p. 199; Lethæa Rossica, Vol. iii, 1853, p. 136, pl. iii, fig. 18.

Pliocene? Zukowce, Russia.

D. LÆVIGATUM Ponzi, 1858, not of Eichwald, 1830. Bull. Soc. Geol. France (2), Vol. xv, p. 558.—*Nomen nudum.*

Pliocene, Rome.

D. LANDINENSE Vincent, 1877. Ann. & Bull. Soc. Malac. Belg., Vol. xi, p. 158–159, pl. ix, figs. 12a-b-c.

Lower Eocene of Belgium.

D. LEBUENSE Philippi, 1887. Tertiär. und Quartär. Verstein. Chiles, p. 106, pl. xii, fig. 18.

Tertiary of Chili.

D. LEONIÆ Meunier, 1878. Compt. Rend. Acad. Sci. Paris, Vol. 86, p. 122.

Eocene of Paris Basin, Sables-moyens, at Jaignes (Seine-et-Marne).

D. leoninæ SIMROTH, in Bronn, Klassen u. Ordn. des Thier-Reichs, new edit., iii, p. 375.

D. LINNEI Foresti, 1895. Bull. Soc. Malac. Italiana, Vol. xix, p. 246.

Pliocene, Ponticello, val di Savena, Italy.

D. LUCIDUM Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 214, pl. i, figs. 18–20.

D. incertum D'ORBIGNY, 1850, not of Deshayes, 1825. Prodr. Paleont. Strat., Vol. ii, p. 393.

D. nitens DIXON, 1850. Geology of Sussex, p. 95, pl. vii, figs. 3–3a.

Fustiaria lucida NEWTON, 1891. Brit. Oligocene & Eocene Moll., p. 285.

Fustiaria lucida NEWTON & HARRIS, Proc. Malac. Soc. Lond., i, p. 65.

Eocene, Paris Basin, Bracklesham Beds, England.

" D. MAGNISTRIATUM Deshayes " quoted by Anton, Verz. Conch. Anton, p. 25, 1839.

We do not know where it was described; probably nowhere. ?=*multistriatum.*

D. MAGNUM Briart & Cornet, 1889. Mém. Acad. Roy. de Belgique, Vol. 67, p. 81, pl. 24, fig. 6.

Upper Eocene of Mons, Belgium.

D. MAJUS Sowerby, 1846, in Darwin's Geol. Obs. on S. America, p. 263, pl. ii, fig. 3.

Tertiary of Chili, Huefo Island.

D. MANTELLI Zittel, 1865. Novara Exped., Palaeont. N. Seeland, p. 45, pl. 13, fig. 7.

Entalis mantelli TATE, Trans. & Proc. R. Soc. S. Australia, 1887, p. 190.

D. kicksii TENISON-WOODS, Roy. Soc. Tasm. 1875, p. 15.

D. kickii ETHER., Cat. Austr. Foss. p. 162.

Miocene, Pareora, New Zealand; also Victoria, Australia.

D. irregularis HUTTON 1873, (not of Risso, 1826.) Cat. Tertiary Moll. New Zealand, p. 1.

D. tenuis HUTTON, 1873. Cat. Tertiary Moll. New Zealand, p. 1.

Omaru, New Zealand.

D. MAYERI Guembel, 1861. Geognos. Beschreib. Bayerisch. Alpengebirg., p. 745.

Oligocene, Lohergraben, Bavaria.

D. MECHELINII Rouault, 1850. Mém. Soc. Geol. France (2), Vol. iii, pt. 2, p. 473, pl. xv, fig. 6a, b, c.

Eocene, Bos d'Arros (Basses-Pyrenees).

D. MEDIAVIENSE Harris, 1896. Bull. Amer. Palaeont., Vol. i, p. 187, pl. 17, fig. 1 (No. 4, p. 73, pl. 7, fig. 1).

Eocene, Midway stage, Alabama and Mississippi.

D. MICHELOTTII Hoernes, 1856. Foss. Moll. Tertiär Beckens von Wien, p. 654–655, pl. 50, fig. 33.—SACCO, Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 96, pl. 7, f. 84–86, with "varieties" *intercosicillata, rotundulina, rotundosimplex, costulatior, costulatissima* Sacco.

The involved synonymy includes *D. pseudosexagonum* Bonelli, not Dh, *pseudoentalis* Sismonda not Lam., *lamarcki* Mayer (in part).

Miocene of the Vienna Basin and Piedmont.

D. MICROSTRIA Heilprin, 1880. Proc. Acad. Nat. Sci. Phila., 1880, p. 375, pl. 20, fig. 3.

Eocene, Lignitic, Woods Bluff, Alabama.

D. MINUTISTRIATUM Gabb, 1860. Journal Acad. Nat. Sci. Phila., (2d Ser.), Vol. iv, p. 386, pl. 67, fig. 46.

Lower Claiborne Eocene of Texas.

D. MIOCENICUM Michelotti, 1847. Descr. Foss. Terr. Mioc. Ital. Septrion, p. 144–145, pl. 16, fig. 12.—*Entalis miocenica* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 108, pl. 9, f. 31–35.

Lower Miocene of Piedmont.

D. MIOPSEUDOENTALIS (Sacco), 1897.

Entalis miopseudoentalis SACC., Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 106, pl. 9, f. 7–11, with var. *costatior* Sacc.

Miocene of Piedmont.

D. MISSISSIPPIENSE Conrad, 1847.

D. mississippensis CONRAD, Proc. Acad. Nat. Sci. Phila., 1846–7, p. 282; figured in the Journ. Acad. Nat. Sci. Phila. (2), Vol. i, pl. xi, fig. 1.

D. densatum CONRAD, Amer. Journ. of Conch. i, p. 212, pl. 20, f. 15.

Oligocene, Vicksburg, Mississippi.

D. virginianum CHENU, Ill. Conch., i, pl. 4, f. 8, 8a, 8b, undescribed, may possibly be this species. *D. densatum* Conr. (from type) is a fragment of an old individual of *Mississippiense.*

D. MONTENSE Briart & Cornet, 1889. Mém. Acad. Roy. de Belgique, Vol. lxvii, p. 60, pl. 24, figs. 12 a–b.

Upper Eocene of Mons.

D. MULTANNULATUM Aldrich, 1895. Bull. Amer. Pal., Vol. i, p. 55, pl. 1, f. 3 (No. 2, p. 3, pl. 1, fig. 3).

Eocene, Lignitic, Gregg's Landing, Ala.

D. NANUM Hutton, 1873. Cat. Tertiary Moll. New Zealand, p. 1; figured in the Macleay Memorial Volume, 1893, pl. viii, fig. 78.

Pliocene, New Zealand.

D. NAVIDADENSE Pilsbry & Sharp, 1898. New name for *D. gracile* Philippi, 1887, preoc.

D. gracile PHILIPPI 1887, (not of Hall and Meek.) Tertiär. und Quartär. Verstein. Chiles, p. 107, pl. xii, fig. 15.

Tertiary of Chili.

D. NICEENSE Bellardi, 1850. Liste foss. Form. Nummulit. de Nice, Bull. Soc. Géol. France (2), Vol. vii, p. 681. (No description, but probably described in Mém. Geol. Soc. de France, Vol. iv, p. 229, which we have not seen).

D. nitense GUEMBEL, 1861. Error for *D. niceense* Bellardi, 1850, Guembel, Geogn. Beschr. Bayer. Alpengeb., 1861, p. 604.

Oligocene, Nice, etc.

D. NITENS J. Sowerby, 1814. Mineral Conchology, Vol. i, p. 159, pl. 70, fig. 1–2.

Fustiaria nitens (J. Sowerby) NEWTON, Syst. List Edwards Coll. B. M., 1891, p. 285.

London clay, Lower Eocene, England.

D. NITIDUM Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 203, pl. 1, figs. 29–30.

Eocene, Paris Basin.

D. NOBILE Mayer, 1863. Journ. de Conch. (3), Vol. iii, p. 97.

Lower Tertiary of Hoering.

D. NOVAKI von Koenen, Norddeutsch. Unteroligoc., iv, p. 978, pl. 59, f. 78; Journ. de Conch., 1892, 330.

D. acutum DH., Descr. An. S. V. B. Paris, ii, p. 205, pl. 20, f. 1–4 (not of Hébert).

Morigny, France.

D. NOVUM Chenu, 1842. Illustr. Conch., Vol. i, p. 5, pl. 6, fig. 23.

Tertiary; locality and horizon unknown.

D. NOVEMCINCTUM Sacco, 1897. Moll. Terr. Terz. Piemonte, etc., xxii, p. 97, pl. 7, f. 97.

Oligocene, Tongrian stage, Sasselo, Italy.

D. NOVEMCOSTATUM Lamarck (p. 51).

D. mutabile Doderlein 1856, in Hoernes, Moll. Tertiär. Beckens von Wien, p. 654, pl. 50, fig. 32.

Miocene of the Vienna Basin and Italy.

Varieties *pseudaprina* Sacc., *mutabilis* Doderlein, *inæquicostata* Dautzenb., *decemcostulata* Sacc., *undecimcostata* Sacc., *duodecimcostata* Sacc. and *tredecimcostata* Sacc. are described and figured by Sacco, Moll. Terr. Terz. Piemonte e Liguria, xxii, pp. 103, 104, from the Italian Miocene and Pliocene.

D. OBSOLETUM Doderlein 1862 (not of Schlotheim, 1832). Cenni geologici intorno la giacitura dei terreni miocenici superiore dell' Italia centrale, p. 15, in Atti de x Congr. d. Scienz. ital. ten. in Sienna, 1862 (not seen by us).

Upper Miocene, Piedmont.

Said to = *D. dentalis* var. *sublævis* Cocconi, 1873.

D. OCTOCOSTELLATUM Pilsbry & Sharp, 1898. New name for *D. octocostatum* Ihering, 1398, not of Frass, 1867.

D. octocostatum Ihering, 1898. Revista do Museu Paulista, ii, p. 266, pl. 4, f. 16.

Santa Cruz Formation, Patagonia.

D. OTTOI Sharp & Pilsbry, 1898. New name for *D. compressum* Meyer, 1883, not of Orbigny, 1850.

D. compressum MEYER, 1883. Bericht. Senckenb. Naturforsch. Gesellsch., 1883, p. 258, figs. 4 a–c.

Oligocene, Germany.

D. PAREORENSIS Sharp & Pilsbry. New name for *D. laevis* Hutton, 1873.

D. laevis Hutton, 1873 (not of Schlotheim, 1820), Cat. Tertiary Moll. New Zealand, p. 2.

Tertiary (Pareora), New Zealand.

D. PARISIENSE D'Orbigny, 1850. Prodr. Paleont. Strat., Vol. ii, p. 372, No. 701; figured in Deshayes Descr. Anim. s. Vert. Bassin Paris, Vol. ii, pl. 2, figs. 17–19.

D. semistriatum DESHAYES, 1825 (not of Turton, 1819). Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 367, pl. xvii, fig. 15–16.

Fustiaria parisiensis R. B. NEWTON, Brit. Oligocene & Eocene Moll., p. 286, 1891; *Entaliopsis parisiensis* NEWTON & HARRIS, Proc. Malac. Soc. Lond., i, p. 68.

Eocene of Paris Basin and Bracklesham Beds, England.

D. PARVUM Mayer, 1864. Journ. de Conch. (3), Vol. iv, p. 358, pl. xiv, fig. 6.

Upper Tertiary, Léognan, France.

D. PASSERINIANUM Cocconi, 1873. Mem. Accad. Sci. Bologna (3), Vol. iii, p. 646, pl. vi, figs. 18–19.—SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 96, pl. 7, f. 76–79, with var. *striatissima.*

D. striatissimum DODERLEIN, 1862. Giac. Terr. Mioc. Italia Centr., p. 15 (in part), and of some other authors.

Piacenzian, at Castelnuovo d'Asti, Majatico, Bordighera, etc., Italy.

D. PELLUCENS Desbayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 214, pl. 1, figs. 21–23.

Fustiaria pellucens NEWTON, 1891. Brit. Oligocene & Eocene Moll., p. 286.

Upper & Middle Eocene of England; Paris Basin.

D. PHILIPPIANUM Pilsbry & Sharp, 1898. New name for *D. parvulum* Phil. not Stoliczka.

D. parvulum Philippi, 1887. Tertiär. und Quartär. Verstein. Chiles, p. 107, pl. xii, fig. 16.

Navidad and Lebu, Chili.

D. PHILIPPII Chenu, 1842. Illustr. Conch., Vol. i, p. 6, pl. 6, fig. 17.

Miocene or Pliocene of Italy.

Doubtless identical with some of the well known ribbed species of *Antalis* from this region.

D. PLANATUM Bronn, 1831. Ital. Tert. Gebild. (Heidelberg), p. 84.

Tertiary, Italy.

D. PLEIOCENUM Tuomey & Holmes, 1857. Pliocene Fossils of South Carolina, etc., p. 105–106, pl. xxv, fig. 2.

Pliocene, Pee-dee, South Carolina.

D. POLYEDRUM Seguenza, 1879. Form. Terz. Prov. Reggio (Calabria), p. 275.

Pliocene, Astian Stage, Italy.

D. PRÆCURSOR Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 472, pl. 11, f. 12–14.

Oligocene of San Domingo.

D. PRISMA Dall, 1892. Trans. Wagner Inst., iii, p. 442, pl. 15, f. 5.

Pliocene of the Caloosahatchie River, Florida.

D. PRISMATICUM Seguenza, 1880. Form. Terz. Prov. Reggio (Calabria), Real. Accad. Lincei, An. 1878–80, p. 117, pl. xi, figs. 49, 49a.

Miocene, Tortonian Stage, Italy.

D. PROLIFERUM Chenu, 1842. Ill. Conch., Vol. i, p. 6, pl. 4, fig. 5.

Pliocene or Miocene, Italy.

D. PSEUDOANTALIS Lamarck, 1818. Anim. s. Vert., Vol. v, p. 345; figured in Deshayes as *D. pseudo-entalis*, Descr. Anim. s. Vert. Bassin Paris, Vol. ii, pl. 1, figs. 4–6.

D. pseudo-entalis DEFRANCE, Dict. Sci. Nat., Vol. xiii, p. 72.

Eocene of the Paris Basin.

D. PSEUDONYMA Pilsbry & Sharp. New name for *Teredo substriata* Conr., 1850, not *D. substriatum* Desh., 1825.

Teredo substriata CONRAD in Dana's Geology of the U. S. Expl. Exped. (Wilkes) Appendix, p. 728, pl. 20, f. 7, 7a, 7b.

Miocene, Astoria, Oregon.

D. PYRUM Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 472, pl. 11, f. 12–14.

Oligocene of San Domingo.

D. QUINDECIESSTRIATUM Eichwald, 1853. Lethæa Rossica, Vol. iii, p. 137 ; Atlas, pl. iii, fig. 19.

D. striatum EICHWALD, 1830 (not of Lamarck, 1818). Nat. Hist. Skizze von Lithuanen, etc., p. 199.

Pliocene, Zukowce, Russia.

D. RADULA Schroeter, 1784. Einleitung in die Conchylien Kenntniss, Vol. ii, p. 530.—GMEL., Syst. Nat., (xiii), p. 3,738.

D. aspersum MICHELOTTI, 1847. Descr. foss. Terr. Miocènes Italie Septentrion, p. 144, No. 6, pl. 5, figs. 20–21.—*Coccodentalium radula* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 111, pl. 10, f. 7–21, with varieties *gracillima* and *raricostata* Sacc.

? Dentalites radularis SCHLOTHEIM, Die Petrefactenkunde, p. 95, (1820).

Upper Miocene, Tortonian stage, Stazzano, S. Agate and Montegibbio, Piedmont.

D. RECTUM Gmelin, 1788. Syst. Nat. (13), p. 3,738.—*D. delessertianum* CHENU, Illustr. Conch., i, p. 3, pl. 6, f. 10.—*D. elephantinum* of various authors upon Italian Tertiary fossils, not of Linné. —*Entalis recta* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p.

110, pl. 10, f. 1–6, with varieties *pliocenica*, *dertonensis* and *elaticosta* of Sacco.—*D. sulcatum* Scacchi, not. Lam. See also Searles V. Wood, Crag Moll. Suppl., 1872, pl. 5, f. 19.

Var. Mónterosatoi Pils. & Sharp, 1898. New name for *D. Philippii* Monts. not Chenu.

D. striatum Philippi, 1844. Enum. Moll. Siciliæ, Vol. ii, p. 208. (1844). Not of Born.

D. philippii Monterosato, 1872. Notiz. Conch. foss. Monte Pellegrino e Ficarazzi, p. 27, for *D. striatum* Philippi, not of Lamarck; see also De Franchis, Bull. Soc. Mal. Ital., xix, p. 202, pl. 2, f. 11; pl. 3, f. 2.

D. delessertii De Stefani, Excurs. Scient. Calab., pp. 236, 241 (1883–4); Osservaz. Stratigr. sul Plioc. e sul Postplioc. di Sciacca, pp. 14, 17, 18, 22 (1889).

This form is distinct from *D. badense* Partsch (Hörnes Abh. K.-K. Geol. Reichsaust, iii, p. 652, 1856), which Hörnes identifies with *striatum* Lam, and Phil. De Franchis claims *D. delessertianum* to be identical with *philippii*, but his figures do not bear out the statement, in our opinion. We think it a recognizable variety.

Pliocene, Southern Italy.

See also this Vol., pp. 81, 82, *D. rectum* and *D. delessertianum*, with the figures and references there given.

D. rex Pilsbry & Sharp, 1898. New name for *D. giganteum* Chenu, 1842, not Phillips, 1836.

D. giganteum Chenu, 1842 (not of Phillips, 1836), Ill. Conch., Vol. i, p. 4, pl. 1, fig. 3.

Locality and horizon unknown.

D. rubescens Deshayes. (See p. 105).

D. fissura of Bonelli, Bronn, Sismonda and some other writers on Italian Miocene fossils.—*Pseudantalis rubescens* Sacco, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 111, pl. 10, f. 21–23.

Miocene and Pliocene of Italy. Recent.

D. rubescens var. exdispar (Sacco), March, 1897. L. c., p. 112. New name for *D. dispar* Mayer, not Sowerby.

D. dispar C. Mayer in Cocconi Mem. Accad. Sci. Istit. Bologne, (series 3), Vol. iii, p. 650, pl. 6, f. 20–22 (1873).

D. cocconii Sharp & Pilsbry, 1897. This Vol., p. 87 (Oct., 1897). New name for *D. dispar* C. Mayer in Cocconi, not of Sowerby.

Miocene, Majatico, Italy.

D SANDBERGERI Bosquet, 1859. Neerland. Verh. Kon. Akad. Wetensch.. Vol. vii, p. 20, pl. ii, fig. 7.

D. entalis BRAUN (not of Linn.) Walchn. Geognos., II Aufl., p. 1,121 (quoted by Pictet & Campiche, Paleont. Suisse).

D. fissura NYST, 1843 (not of Lamarck, 1818). Mém. Courron. Sav. Etrang. Brussels, Vol. xvii, p. 346.

Eocene, Paris Basin, etc.

D. SEMIALTERNANS Chenu, 1842. Illustr. Conch., Vol. i, p. 7, pl. 4, fig. 7.

Horizon and Habitat unknown. Probably Tertiary.

D. SEMICLAUSUM Nyst, 1835. Recherches Coq. foss. prov. Anvers, p. 36, pl. 5, fig. 53. See also Nyst, Ann. Mus. Roy. d'Hist. Nat. Belg., iii, pt. 1, p. 120, pl. 7, f. 14.

Pliocene, Scaldisien stage, near Antwerp, Belgium.

D. SEMINUDUM Deshayes, 1864. Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 200, pl. 3, figs. 11–14.

Eocene of the Paris Basin.

D. SEXANGULUM Gmelin, 1788. Syst. Nat. (13), p. 3,739, no. 21.—BROCCHI, Conch. foss. Subapp., ii, pl. 15, f. 25.—SACCO, Moll. Terr. Terz. Piemonte e Liguria, pt. 22, p. 92, pl. 7, f. 48, to 54.

D. elephantinum BROCCHI, t. c., p. 260 (in part).—DESHAYES, Mém. Soc. Hist. Nat. Paris, p. 347, 348.—RISSO, Hist. Nat. Eur. Mérid., iv, p. 399, and of some other authors.

D. sexangulare LAMARCK, 1818. Anim. s. Vert., Vol. v, p. 344, and of most other authors.

D. sexangulare var. *acutangularis* Cocconi, 1873. Mém. Accad. Sci. Bologna, 3°, Vol. iii, p. 645.

D. sexangulare var. *subrecta* Cocconi, 1873. Mem. Accad. Sci. Bologna, 3°, Vol. iii, p. 645.

? D. noe Bonelli in SISMONDA, Osserv. Miner. e Geol. Piemonte, p. 35. D'Orbigny, Prodr. Paléont. Strat., Vol. iii, p. 178. No. 255. This may be referable to *D. subsexangulare* Orb., q. v.

D. SIMPLEX Michelotti, 1861. Et. Mioc. Inf., in Natuurkundige Verhandl. Hollandsche Maatschappij Wetenschappen te Haarlem (2), xv, p. 136, pl. 13, f. 12, 13.

Oligocene of Italy, at Carcare, Dego, Mioglia, Pareto, Cassinelle, etc.

D. SOLIDUM Hutton, 1873. Cat. Tertiary Moll. New Zealand, p. 2.

Tertiary (Pareora), New Zealand.

Referred to *D. giganteum* Sowb. as a synonym by some authors.

D. SOWERBYI Chenu, 1842 (not of Guilding, 1834). Illustr. Conch., Vol. i, p. 7, pl. 6, fig. 2. Locality and horizon unknown; but it is probably a Pliocene specimen of *D. entalis* L. or some closely allied species.

D. SOWERBYI Michelotti, 1847 (not of Guilding, 1834, nor of Chenu). Descr. foss. terr. mioc. Italie Septentr., p. 145.

Miocene, Turin.

D. SPECIOSUM Guembel, 1861. Geognos. Beschreib. Bayerisch. Alpengebirg., p. 668.

Eocene, Bavarian Alps.

D. SPIRALE Risso, 1826. Hist. Nat. Europ. Mérid., Vol. iv, p. 401.

Pliocene? "Trinité."

D. SUBCOMPRESSUM Meyer, 1885. Amer. Journ. Sci., Vol. 29, p. 462, figured in Alabama Geol. Surv. Bull. No. 1 (2), 1886, pl. 3, fig. 3, 3a; also Proc. Acad. Nat. Sci., 1887, p. 54, pl. iii, fig. 13 (Vicksburg).

Eocene and Oligocene: Jackson Red Bluff and Vicksburg, Miss.

The figured type-specimen is from Jackson (Meyer).

D. SUBEBURNEUM d'Orbigny, 1850. Prodr. Pal. Strat., ii, p. 372.

D. eburneum G. B. SOWERBY, Genera Rec. & Foss. Shells, 1825, no. 15, f. 6; Desh., Descr. Annim. S. Vert. Bassin Paris, 1861, ii, pp. 215, 216, pl. 2, f. 8–13. Not of Linnæus.

Fustiaria circinata R. B. NEWTON, Syst. List Edwards Coll., B. M., 1891, p. 284. Not *D. circinatum* Sowb.

Fustiaria subeburnea Orb., NEWTON & HARRIS, Proc. Mal. Soc. Lond., i, p. 65.

Eocene, Paris Basin and England.

The last-quoted authors distinguish this as a species distinct from the recent *eburneum* Linn. (from type), and the Eocene *circinatum* Sowb.

D. SUBENTALIS d'Orbigny, 1850. New name for *D. entalis* Lamarck and Deshayes, Prodr. Paleont. Strat., Vol. II, p. 320, No. 431.

Lower Eocene, Suessonien, Cuise-Lamotte, etc., France.

Probably a synonym of *D. entale.*

D. SUBFISSURA (Tate) 1887.

Entalis subfissura Tate. Trans. & Proc. R. Soc. S. Austral., Vol. ix, p. 191, pl. xx, figs. 4a–4b.

Earlier Tertiary, south Australia.

D. SUBGIGANTEUM d'Orbigny, 1852 (new name for *D. giganteum* Sowerby, 1846, not of Phillips, 1836). Prodr. Paléont. Strat., Vol. iii, p. 94, No. 1,764.

D. giganteum SOWERBY, 1846 (not of Phillips, 1836). Darwin's Geol. Observations on S. America, p. 263, pl. ii, f. 1.

D. corrugatum Hupé in GAY, 1854. Hist. Chili, p. 276, Atlas Zool., pl. 2, fig. 8.

Earlier Tertiary, coast of Topocaima, Chili; also New Zealand Miocene.

D. SUBIRREGULARE Pilsbry & Sharp, 1898. New name for *D. irregulare* Seguenza not Risso.

D. irregulare SEGUENZA 1879, Form. Terz. Prov. Reggio (Calabria), p. 275, pl. 10, f. 33, 33a.

Pliocene, Astian Stage, Italy.

D. SUBSEXANGULARE d'Orbigny, 1852. New name for *D. sexangulare* Deshayes, 1825. Prodr. Paléont. Strat., Vol. iii, p. 94, No. 1,755.

D. subsexangulatum D'ORBIGNY, 1852. A mistake for *D. subsexangulare* d'Orb. Prodr. Paléont. Strat., 1852, Index, p. 59.

D. sexangulare DESHAYES, 1825. Mém. Soc. Hist. Nat. Paris, ii, p. 350, pl. xvii, figs. 4–6. Not of Lamarck.

Sacco (l. c.) recognizes and figures varieties *striolatissima* Sacco, *noe* Bon. (=*aprinum* Brocchi and others), *magnocostata* Sacc., *peracuta* Sacc., *acutangularis* Cocc. (=*colligens* Sacc.).

Tortonian stage, Upper Miocene, to the Astian, Upper Pliocene, Piedmont.

D. SUBSTRIATUM Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 366, pl. xviii, figs. 1–2.

Fustiaria substriata NEWTON, 1891. Brit. Oliogocene & Eocene Moll., p. 286.

Entaliopsis substriata NEWTON & HARRIS, 1894. Proc. Malacol. Soc. London, Vol. i, p. 68.

D. acuticostum var., J. DE C. SOW., in Dixon's Sussex, 1850, p. 96, pl. 7, f. 16.

Eocene, Barton and Bracklesham beds, England; Paris Basin.

D. SULCATUM Lamarck, 1818. Anim. s. Vert., Vol. v, p. 343; figured in Deshayes, Descr. Anim. s. Vert. Bassin Paris, Vol. ii, pl. 1, figs. 33–35, 1864.

Eocene of the Paris Basin.

D. SULCOSUM Sowerby, 1846. Darwin's Geol. Obs. on S. America, p. 263, pl. ii, fig. 2.

Tertiary, Navidad Chili.

D. TATEI Sharp & Pilsbry, 1898. New name for *D. triquetrum* Tate, 1887, preoccupied.

D. (?) *triquetrum* TATE (not of Brocchi, 1814). Trans. & Proc. Roy. Soc. S. Australia, Vol. ix, p. 193, pl. xx, fig. 3 (1887).

Tertiary, South Australia.

D. TAUROCOSTATUM (Sacco), 1897.

Antale? taurocostatum SACCO, Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 101, pl. 8, f. 50–54, with varieties *costulatior, atava, octogonalis* and *septemcostata* Sacc.

Oligocene, Elvezian stage, Monte dei Cappuccini, N. Italy.

D. TAUROSTRIATUM (Sacco), 1897.

Entalis taurostriata SACC., Moll. Terr. Terz. Piem. e Ligur., xxii, p. 109, pl. 9, f. 47–57, with varieties *simplicior, subjuvenis, decemcostata, anomalocostata* of Sacco.

Oligocene, Baldissero, northern Italy.

D. TENUISTRIATUM Rouault, 1850. Mém. Soc. Geol. France (2), Vol. iii, pt. ii, p. 473, No. 50, pl. xv, fig. 5.

Eocene of Bos d'Arros (Basses-Pyrenees).

D. THALLOIDE Conrad, 1833.

D. thalloides CONRAD, 1833. Fossil Shells of Tertiary, p. 34; 2d ed., p. 39, pl. 15, fig. 10; figured in Amer. Journ. Sci. (Ser. 2), Vol. i, pl. 1, fig. 2.

D. alternatum LEA, 1833. Contrib. to Geol., p. 34, pl. 1, fig. 2.

D. asgum DE GREGORIO, 1890. Ann. Geol. et Palaeont., 8 Livr., 1890, p. 171, pl. 17, fig. 22, 23 a–b, 24.

D. (*asgum*) var. *tirpum* DE GREGORIO 1890. Ann. Geol. et Palaeont., 8 Livr., p. 172.

D. bimixtum DE GREGORIO, 1890. Ann. Geol. et Palaeont., 8 Livr., p. 172, pl. 17, figs. 32–34.

Eocene, Claiborne, Alabama.

D. TRAUTSCHOLDI v. Koenen, 1868. Bull. Soc. Impér. Naturalistes de Moscou, xli, pt. i, p. 160. New name for *D. badense* Trautsch., not Partsch.

D. badense TRAUTSCHOLD, 1859. Bull. Soc. Impér. Nat. Moscou, xxxii, p. 313, pl. 6, f. 4 a, b, c. Not of Partsch.

Lower Oligocene, Aral Sea.

D. TRIGONUM Hoeninghaus, 1831. Jahrb. Min. Geol., p. 155. *Nomen nudum.*

Tertiary, Tabbiano.

D. TRIQUETRUM Brocchi, 1814. Coq. foss. Subapp., ii, p. 628.—*Gadilina triquetra* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 113, pl. 10, f. 35–46, with var. *taurogracilis* Sacc.

Elvezian, Tortonian and Piacenzian stages, Montegibbio, Bordighera, Monte dei Cappuccini, etc., N. Italy.

D. TRYONI Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 468, pl. 10, f. 5, 9 ; pl. 11, f. 22.

Oligocene of San Domingo.

D. VITREUM Gmelin, 1788. Syst. Nat. (13), p. 3,739, No. 20. —*Antale vitreum* SACCO, Moll. Terr. Terz. Piemonte e Liguria, xxii, p. 100, pl. 8, f. 42–49.

Lower Miocene to Upper Pliocene, Elvezian to Astian stages, northern Italy.

D. VULGARE (Da Costa).

Sacco describes a Pliocene variety *perstriolata* in Moll. Terr. Terz. Piem. e Ligur., xxii, p. 98, pl. 8, f. 1–5.

D. XIPHIAS Sharp & Pilsbry, 1898. New name for *D. affine* Deshayes, 1864, not of Biondi, 1859.

D. affine Deshayes, Descr. Anim. s. Vert. Bassin Paris, Vol. ii, p. 201, pl. 1, figs. 12–14.

Eocene, Paris Basin.

MESOZOIC SPECIES.

D. ALATUM Gardner, 1878. Quart. Journ. Geol. Soc. Lond., Vol. 34, p. 60, 61, pl. iii, figs. 16–20.

Cretaceous, Gualt at Folkstone, England.

D. ANDLERI Oppel, 1856. Jahresh. Ver. für Vaterl. Naturkunde in Wuerttemberg, Jahrg. xii, p. 213.

Lower Lias, zone of Ammonites angulatus, near Vaihingen.

D. ANGULATI Quenstedt, 1852. Handb. Petrefaktenkunde, p. 443. *Nomen nudum.*

Lias of Europe.

D. ARCOTINUM Forbes, 1846. Trans. Geol. Soc. London (Ser. 2), Vol. vii, p. 138, pl. 12, fig. 16.

Cretaceous of India. (Pondicherry).

Antale arcotinum STOLICZKA, 1868. Cret. Faun. Southern India, Vol. ii, p. 445, pl. xxvii, fig. 23.

D. ARCTUM Pichler, 1857. Jahrb. Min. & Geol., p. 695; Gümbel, Geognostische Beschreib. des Bayerischen Alpengebirges, p. 274 (1861).

Trias, Tyrol.

D. BICOSTALE Ryckholt, 1852. Mem. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 71, pl. ii, figs. 43, 44.

Cretaceous, Tournay, Belgium.

This is considered by Gardner a synonym of *D. decussatum* Sowb.

D. BINKHORSTI Pilsbry & Sharp, 1898. New name for *D. nysti* Binkhorst, 1861, not of d'Orb. 1852. See Binkhorst, Monogr. Gastérop. et Céphalop. Craie Supér. du Limbourg, p. 61, pl. 6, f. 2 a, b, c.

Cretaceous of Belgium.

D. CALIFORNICUM Stanton, 1895. Bull. U. S. Geol. Surv. No. 123, p. 62, 63, pl. xii, fig. 3.

Cretaceous (Knoxville beds) California.

D. CHILENSE D'Orbigny, 1847. Voy. Pôle Sud, (Astrolabe and Zelee) Geology, pl. iv, fig. 37, 38.

Cretaceous, Chili.

D. CIDARIS Geinitz, 1849. Qŭadersandsteingebirge, p. 144. New name for *D. striatum* Geinitz, 1839, not of Sowerby.

D. striatum GEINITZ, 1839 (not of Sowerby). Charac. Schicht. u. Petrifac. Saechs. Kreidegebirg., p. 74, pl. 18, fig. 27.

D. striatum "Sowerby," MANTELL, Geol. of Sussex, etc., p. 87, pl. 19, f. 28; Reuss, Verstein. Böhm. Kreideform., p. 41, pl. 11, f. 18. (Not of Sowerby, 1812, nor of Born, 1780).

D. reussianum RYCKHOLT, 1852. Mém. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 70.

Cretaceous, Belgium, Saxony and England.

D. CŒLATULUM Baily (in Salter), 1857. Quart. Jour. Geol. Soc. Lond., Vol. xiii, p. 87, pl. ii, fig. 8.

Cretaceous, Upper Greensand, Aberdeenshire.

D. COMPRESSUM D'Orbigny, 1850. Prodr. Paléont. Strat., Vol. i, p. 233, No. 135.

Jurassic, France.

D. CONFUSUM Sharp & Pilsbry, 1898. New name for *D. alternans*, Ryckholt, Mém. Couronnes et Mém. des Savants Etrangers, pub. par l'Acad. Roy. Sci. de Belgique, 4to, xxiv, 1850, 1851, p. 71, pl. 2, f. 45, 46 (1852). Not *D. alternans* Chenu, 1842.

Turonien, at Visé, Belgium.

D. COOPERII Gabb, 1864. Geol. Surv. California, Paleontology, i, p. 139, pl. 21, fig. 100.

Cretaceous, San Diego, etc., California.

D. CORALLINUM D'Orbigny, 1850. Prodr. Paléont. Strat., Vol. ii, p. 12, No. 201.

Jurassic, La Rochelle, France.

D. CRASSULUM Stoliczka, 1868. Cret. fossils of Southern India, Vol. ii, p. 444, pl. 27, fig. 21.

Cretaceous, India.

D. CRETACEUM Conrad, 1852. U. S. Exped. Dead Sea & River Jordan (Lynch), p. 228, pl. 1, (Appendix), fig. 1.

Cretaceous, Safed, Syria.

"*D. syriacum* Conrad (Off. Rep. App. 1. 1)," so quoted by Frass, 1867. The species there figured is *D. cretaceum* Conrad, 1852. See Frass, Jahrb. Vaterl. Naturkunde, Würtemberg, p. 239.

D. DECORATUM Muenster, 1844. Goldfuss, Petrifac. German., Vol. iii, p. 3, pl. 166, fig. 9.

Trias, St. Cassian.

Angular, somewhat as in *Entalina.*

D. DECUSSATUM Sowerby, 1814. Mineral Conch. Gt. Brit., Vol. i, p. 161, pl. 70, fig. 5.—GARDNER, Quart. Journ. Geol. Soc. Lond., xxxiv, 1878, p. 58, pl. 3, f. 1–12.

Cretaceous, Gualt, Cambridge, England.

D. nutans KNER, 1852. See ALTH, Naturwiss. Abhandl. (Haidinger), iii, p. 226, pl. 4, f. 10.

Cretaceous, Nagorzany, East Galizia.

D. ellipticum SOWERBY, 1814. Mineral Conch. Gt. Brit., Vol. i, p. 161, 162, pl. 70, figs. 6, 7.—*Conf.* GARDNER, l. c., p. 59.

Cretaceous, Folkstone, Kent.

D. DILATATUM Philippi, 1887. Tertiär. und Quartär. Verstein. Chiles, p. 105, pl. xii, fig. 13.

Cretaceous, Chili.

D. DIVISIENSE Gardner, 1878. Quart. Jour. Geol. Soc. London, Vol. 34, p. 60, pl. iii, fig. 15.

Cretaceous, Upper Greensand, Devizes.

D. DUNKERI Sharp & Pilsbry, 1898. New name for *D. rugosum* Dunker, 1848, not of Eichwald, 1846.

D. rugosum DUNKER, 1848, (not of Eichwald, 1846). Kasseler Muschelkalk Mollusken, Programm in der Höheren Gewerbschule in Cassel, p. 16, 17.

Cretaceous, Cassel.

D. ELONGATUM Muenster, 1844. Goldfuss, Petrifac. German., Vol. iii, p. 2, pl. 166, fig. 5.

D. cylindricum ROEMER, (not of Sowerby, 1814). Verstein. Nord. Deutsch. Oolithen. Gebirg., (1836–1838), p. 134.

Lias, Bauz, Bavaria.

D. FILICAUDA Quenstedt, 1852. Handb. Petrifactenkunde, p. 443. pl. 35, fig. 18.

Upper Lias, Doerbach.

D. filicauda opalina QUENSTEDT, 1858. Der Jura, p. 328, pl. 44, fig. 16.

D. FRAGILE (Meek & Hayden), 1856.

D. fragilis MEEK & HAYDEN, Proc. Acad. Nat. Sci. Phila., 1856, p. 69.

Cretaceous, Montana.

D. GARDNERI Sharp & Pilsbry, 1898.

D. acuminatum GARDNER, 1878, (not of Deshayes, 1825). Quart. Journ. Geol. Soc. Lond., 1878, Vol. 34, p. 62, pl. iii, figs. 34–39.

Cretaceous, Great Britian.

D. GEINITZIANUM Ryckholt, 1852. Mem. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 70.

D. medium GEINITZ, Charakteristik der Schichten und Petrefacten des sächsischböhmischen Kreidegebirges, p. 74, pl. 18, f. 25, 26.—REUSS, Verstein. Böhm. Kreideform., pl. 11, f. 4. Not of J. Sowerby.

Turonien, Tournay, Belgium.

D. GIGANTEUM Phillips, 1836. Illustr. Geol. Yorkshire, Vol. i, p. 136, 170, pl. 14, fig. 8.

Lias, Robin Hood's Bay.

D. GLABELLUM Bean, 1839. Magazine of Nat. Hist., Vol. iii, p. 62. *Nomen nudum.*

" Cornbrash Limestone," Scarborough, England.

D. GLABRATUM (Stoliczka), 1868.

Antale glabratum STOLICZKA, Cret. Faun. South. India, Vol. ii, p. 445, pl. xxvii, figs. 24–25.

Cretaceous, India.

D. GLADIOLUS Eichwald, 1846. Geogn. de Russie, p. 447; Lethæa Rossica, 1868, Vol. ii, p. 799.

D. cylindricum G. FISCHER, 1843, (not of Sowerby, 1812). Bull. Soc. Imp. Nat. Moscou, Vol. 16, pt. 1, p. 139.

D. subanceps TRAUTSCHOLD, 1860. Bull. Soc. Imp. Nat. Moscou, Vol. 33, pt. 2, p. 350–352, pl. viii, figs. 16–17.

Jurassic, Oxfordian stage, Goliowo and other localities near Moscow, etc., Russia.

D. GRACILE (Hall & Meek,) 1854.

D. gracilis HALL & MEEK, Mem. Amer. Acad. Arts & Sci., Vol. v, (new series), p. 393, pl. 3, fig. 11 a–c.

Cretaceous, Montana and Wyoming.

D. JEFFREYSI Gardner, 1878. Quart. Jour. Geol. Soc. London, Vol. 34, p. 61, pl. iii, figs. 26–33.

Cretaceous, Gault at Folkstone, England.

D. LÆVE (Schlotheim), 1820.

Dentalites lævis SCHLOTHEIM, Die Petrifactenkunde, 1820, p. 93.

Trias, Germany, Denmark.

D. LATICOSTATUM Reuss, 1844. Geognos. Skizz. Boehm., Vol. ii, p. 201. We have not seen this work.—Reuss, Verstein. Boehm. Kreideformation, 1845–6, Abth. i, p. 41, pl. xi, fig. 3.

Cretaceous, Bohemia.

D. LINEATUM Gueranger, 1853. Essai d'un Répert. Paléont. de la Sarthe, p. 33. Quoted by Pictet & Campeche, Pal. Suisse (3), 2d pt., p. 726. We have not seen the work.

Cenomanian, Mans, France.

D. MAJOR Gardner, 1877. Geol. Mag. (Dec. ii), Vol. iv, p. 556, pl. xvi, fig. 2.

D. majus GARDNER, 1878. Quart. Jour. Geol. Soc. London, Vol. 34, p. 56, 61.

Cretaceous, Folkstone; Grey Chalk, Dover.

D. MEDIUM Sowerby, 1814. Mineral Conchology, Vol. i, p. 181, pl. 79, fig. 5.—GARDNER, Q. Jour. Geol. Soc. Lond., xxxiv, 1878, p. 59, pl. 3, f. 13, 14.

Cretaceous, Blackdown, England.

D. MEYERI (Gardner), 1878.

Entalis meyeri GARDNER, Quart. Jour. Geol. Soc. London, Vol. 34, p. 62, pl. 3, fig. 40.

Cretaceous, Great Britain.

D. MICHAUXIANUM Ryckholt, 1852. Mém. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 72–73, pl. ii, figs. 47–48.

D. ellipticum "Sowerby," REUSS, Verstein. Böhm. Kreideform., p. 41, pl. 11, f. 20. Not of Sowerby, 1812.

Turonien, near Liege, Belgium.

D. MINIMUM Strickland, 1845. Geol. of Cheltenham, p. 101.—TATE, Quart. Journ. Geol. Soc. Lond. xx, 1864, p. 111.

"*D. tenue* PORTLOCK, Rep. Geol., Londonderry, 1843," p. ? . Not of Goldfuss.

Lias, Cracombe; Island Magee, Antrim Co., Ireland.

D. MOOREI Pilsbry & Sharp, 1898. New name for *D. lineatum* Moore, 1870, not Gueranger, 1853.

D. lineatum MOORE, 1870, (not of Gueranger, 1853). Quart. Jour. Geol. Soc. London, Vol xxvi, p. 256.

"*Queensland Series*," *Wollumbilla, Queensland, Australia.*

The description is nearly worthless, but it will doubtless be identified by the locality and horizon.

D. MOREANUM "D'Orbigny, 1845" in Murchison, Verneuil et Keyserling, Géol. Russ. d'Eur et de l'Oural, Vol. ii, p. 454, pl. 38, fig. 10.

Jurassic, Lower Oxfordian stage, France and Russia.

D. moreauanum BRONN, Nomencl. Pal., 415.—EICHWALD, Lethæa Rossica, ii, p. 797.

D. MUELLERIANUM Pilsbry & Sharp, 1898. New name for *D. alternans* Muller, 1849, (*q. v*), not of Chenu, 1842.

D. alternans Müller, 1849. Programm Koen. Gymnasiums Aachen, p. 5, pl. iii, fig. 1. Reprinted in the Monograph. Petrifac. Aachener Kreideformation, ii Abth., which was published by the Ver. Preuss. Reinl. & Westphal., Bonn, 1851, p. 5, pl. iii, fig. 1. (Not *D. alternans* Chenu, 1842).

Cretaceous, "Königsthore," near Aix la Chapelle.

D. MUENSTERI Sharp & Pilsbry, 1898. New name for *D. cinctum* Münster in Goldfuss, not of de Konick.

D. cinctum Muenster, 1844 in Goldfuss, Petrifact. German., Vol. iii, p. 3, pl. 166, fig. 7.

Jurassic, Derneburg, Germany.

D. MULTICANALICULATUM Guembel, 1861. Geogn. Beschreibung d. bayr. Alpengeb., p. 572; figured in Boehm, Palaeontographica, Vol. 38, 1891, p. 69,pl. 3, fig. 1 a–b.

Cretaceous, Bavaria.

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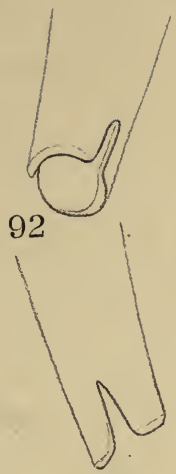

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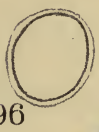

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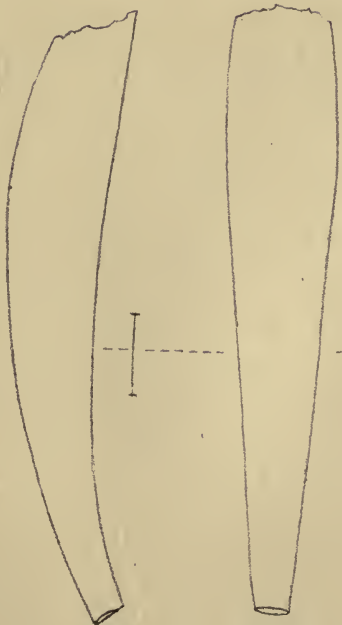

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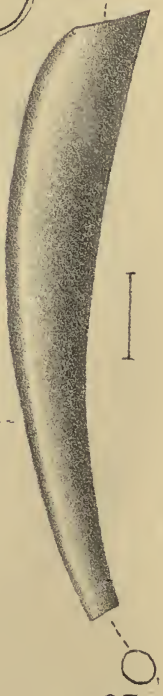

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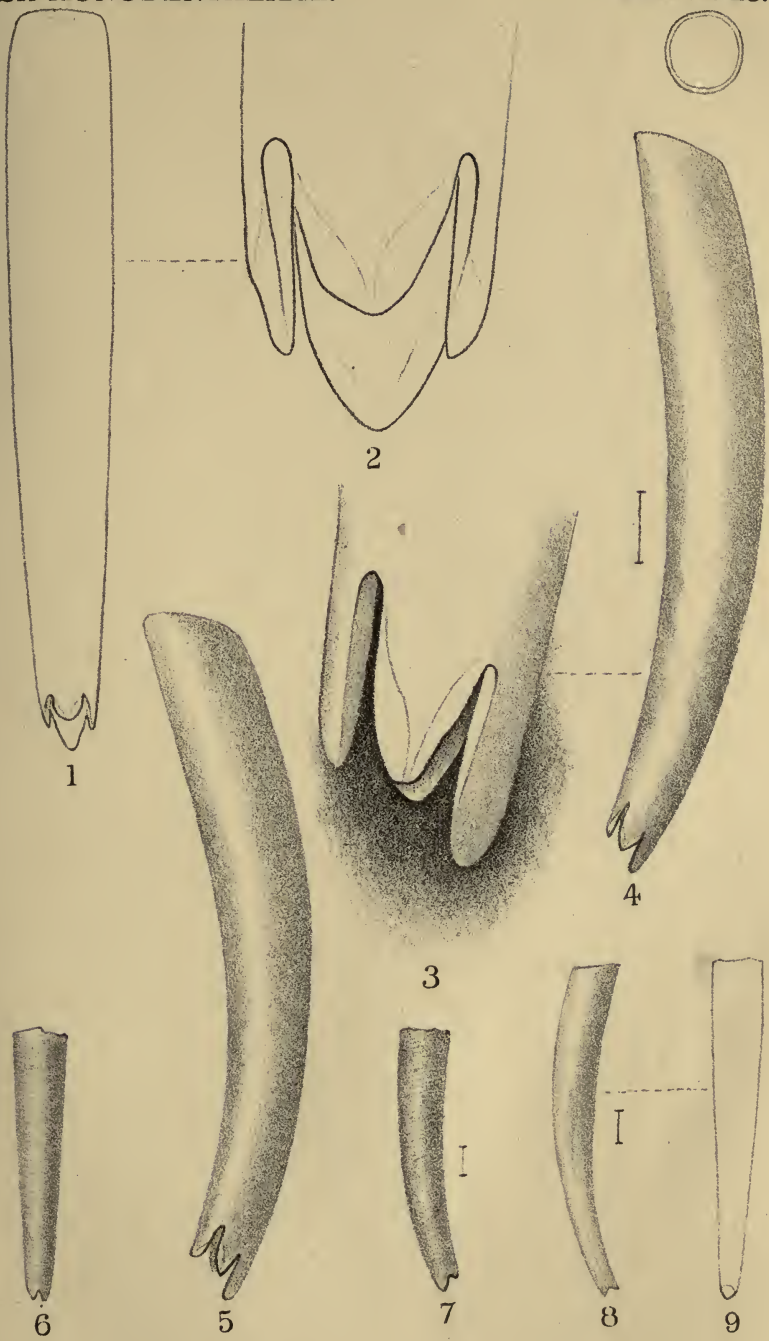
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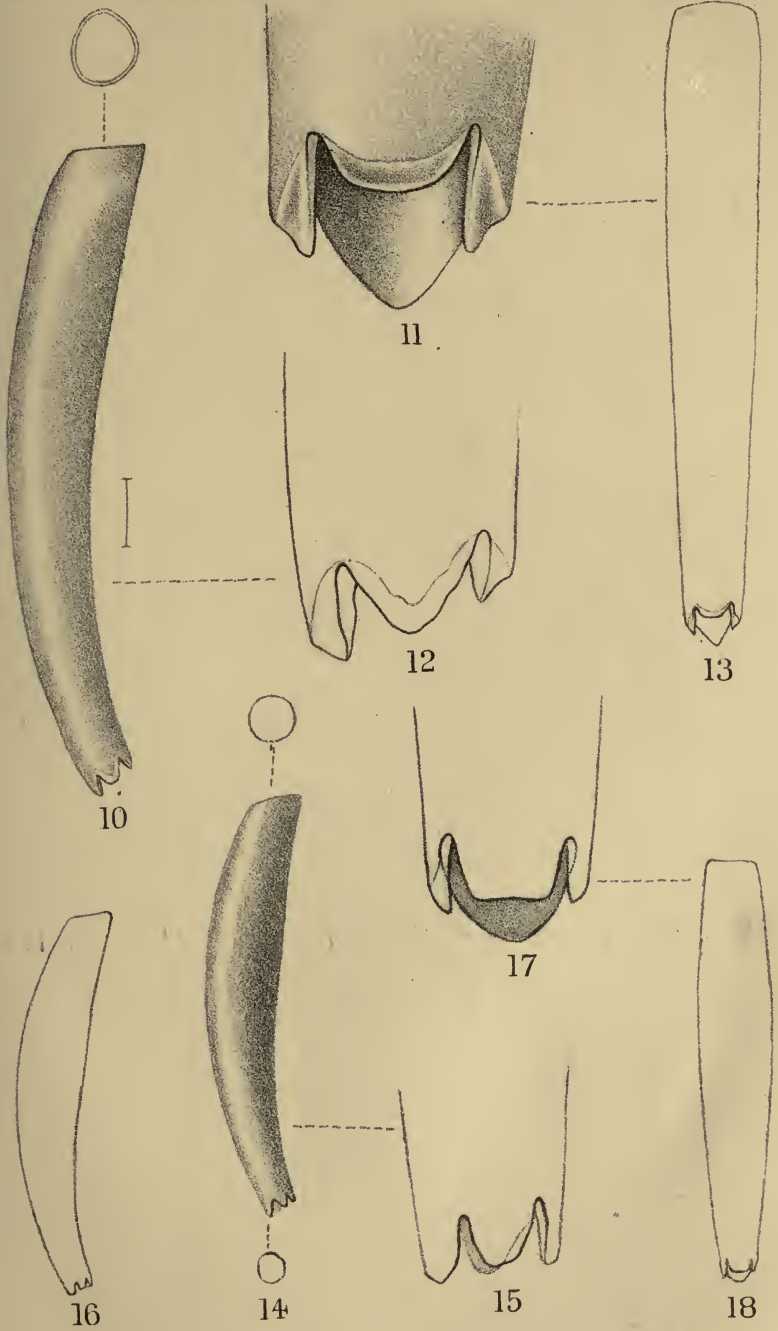
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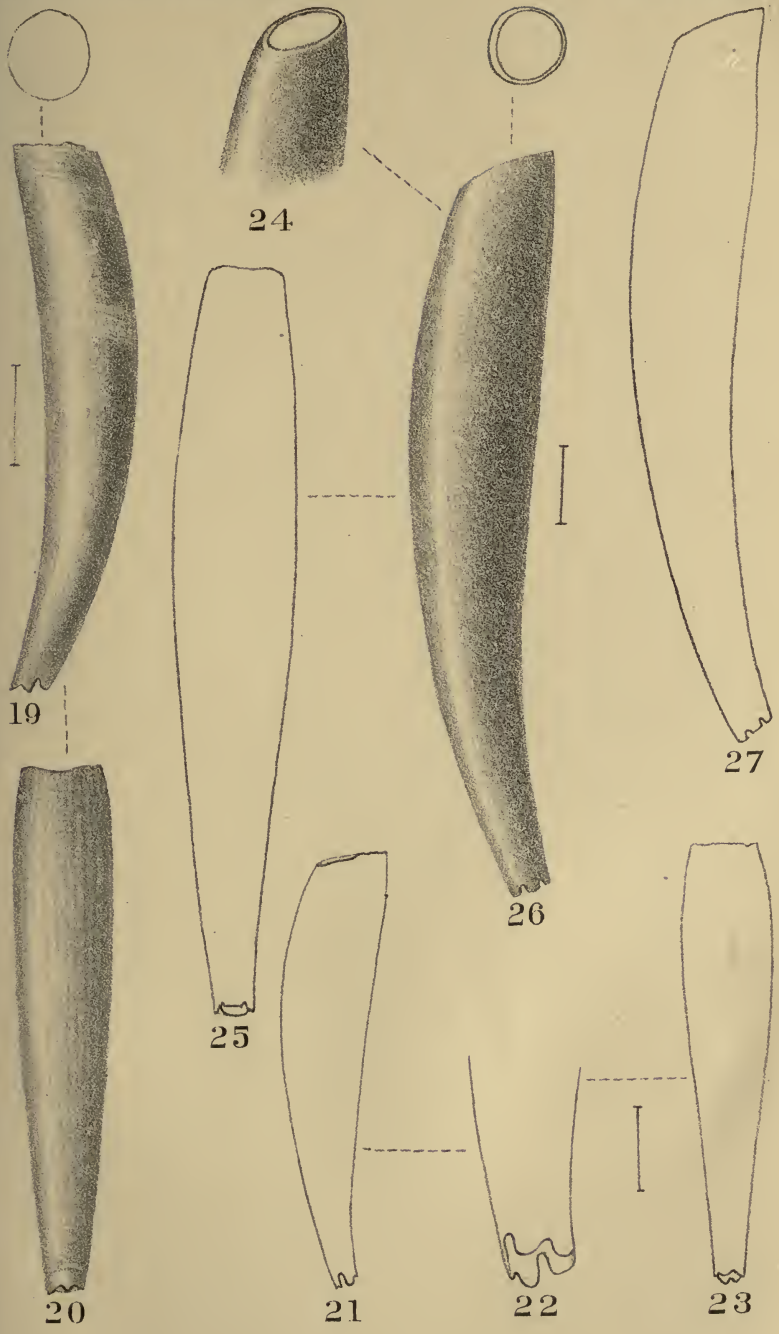
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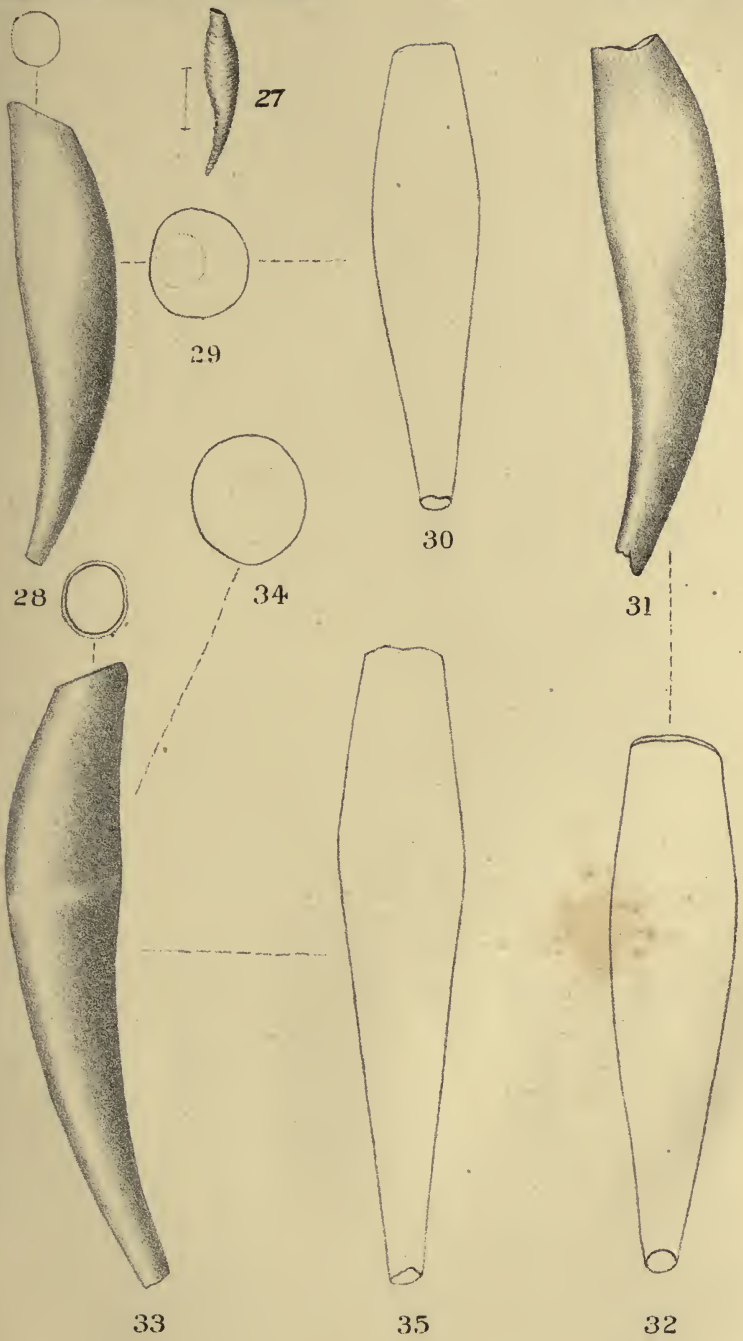
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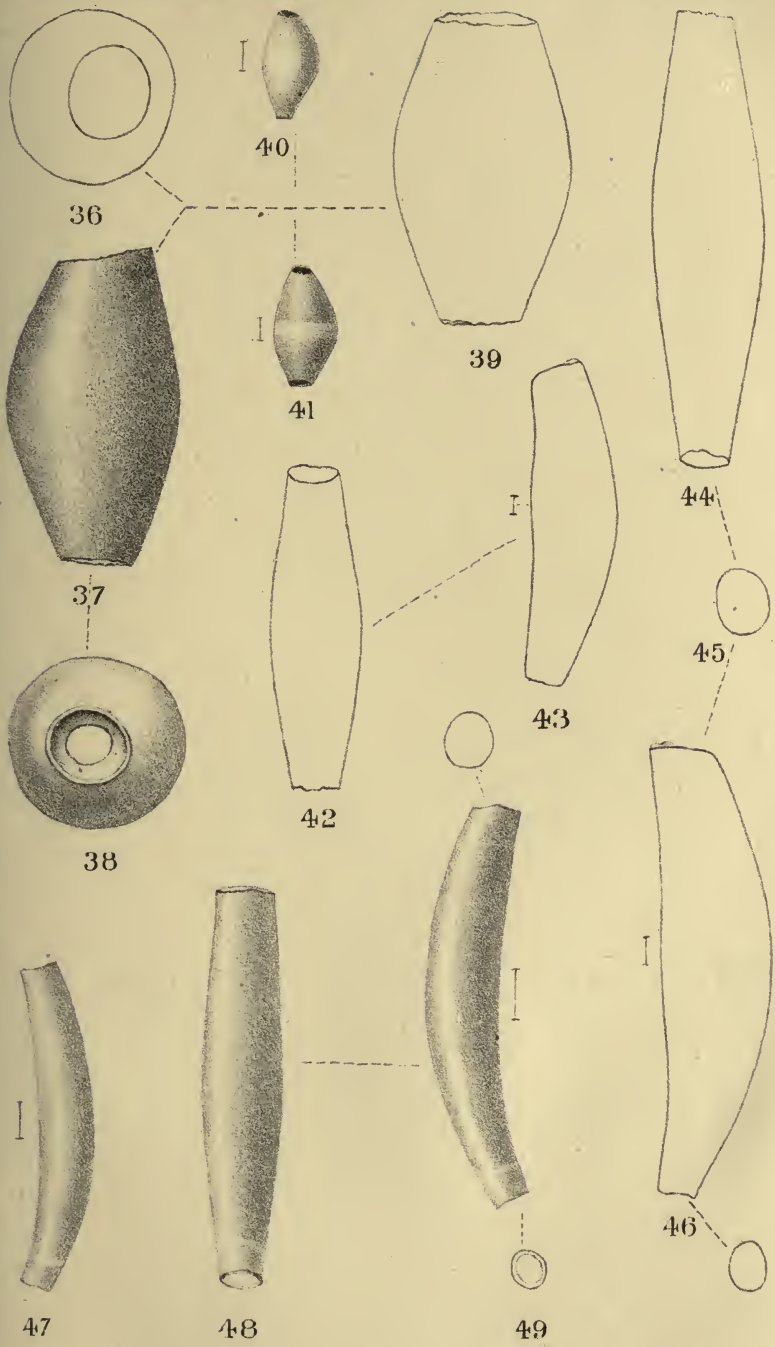
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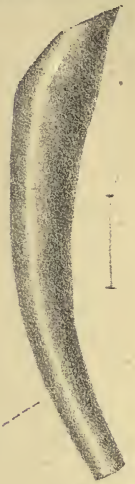

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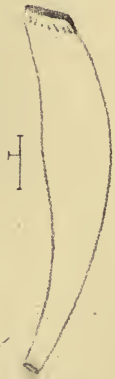

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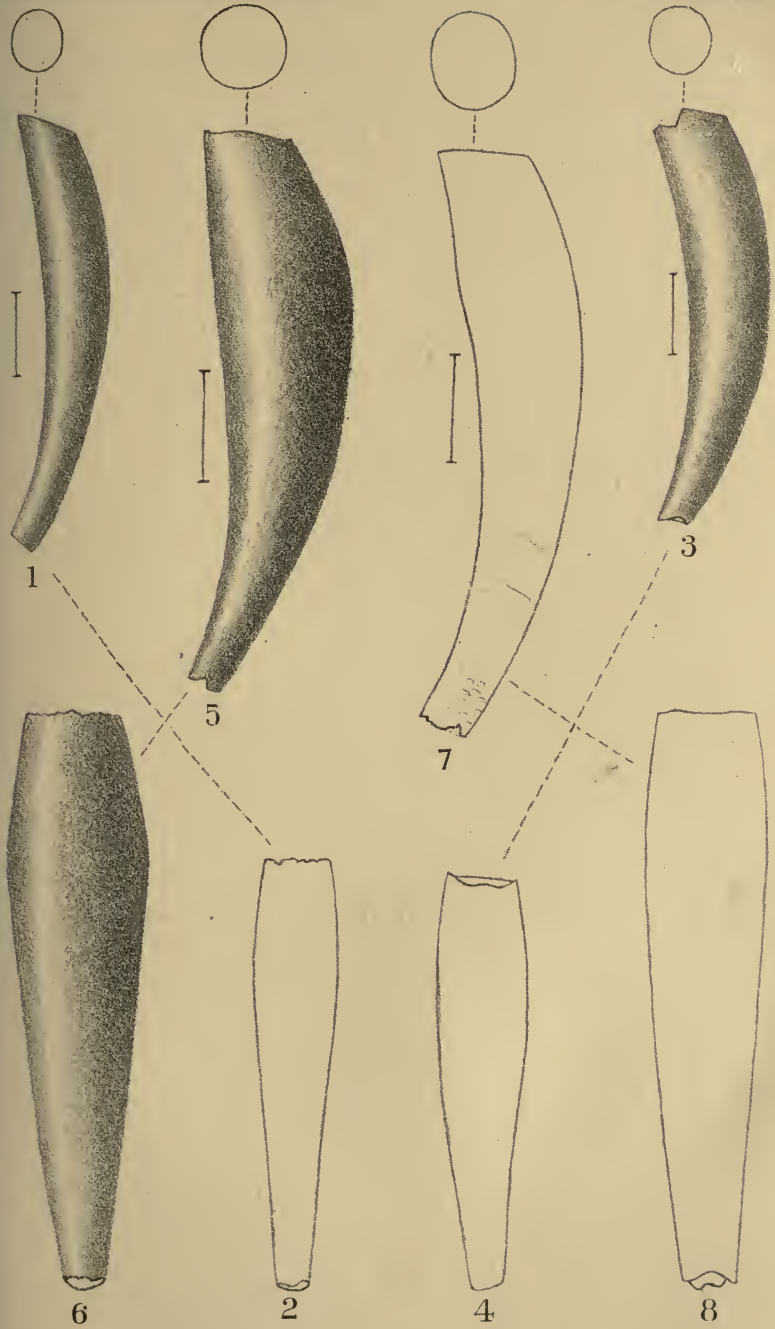
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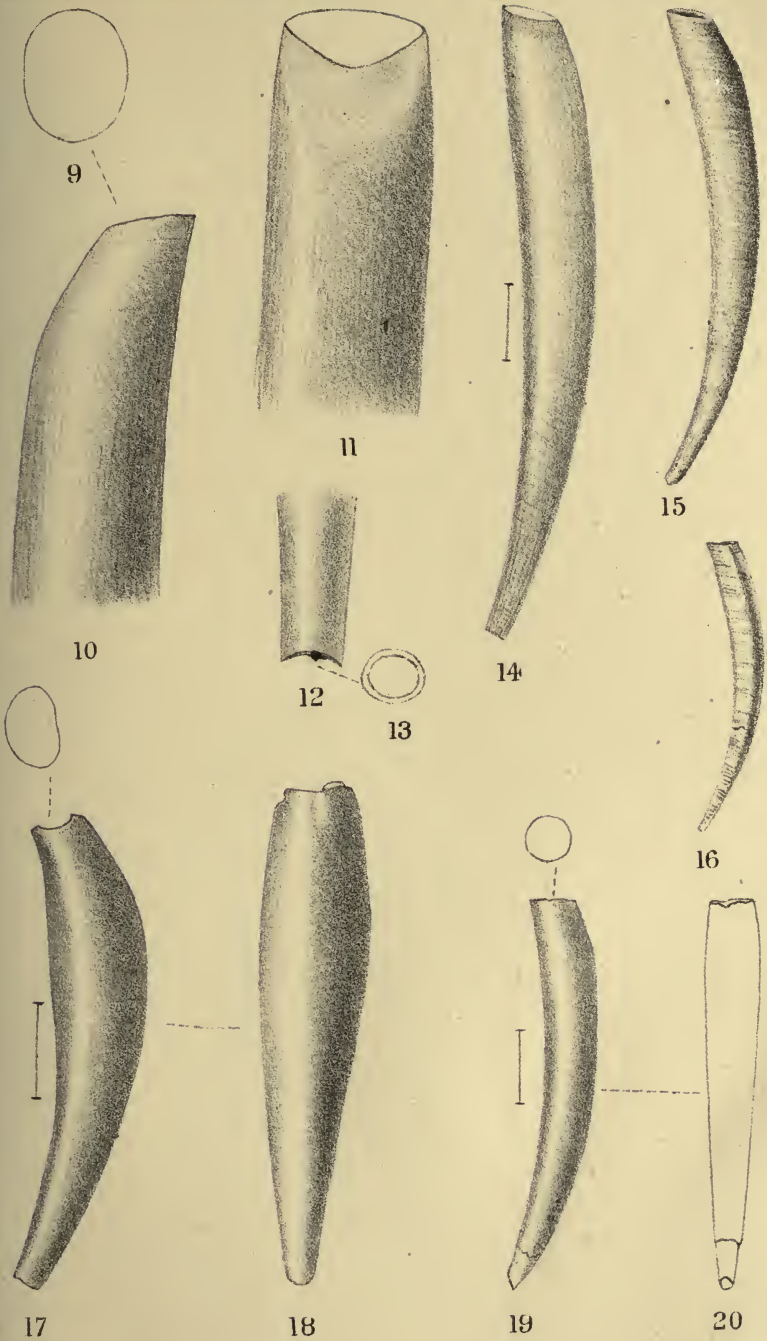
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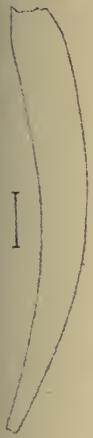
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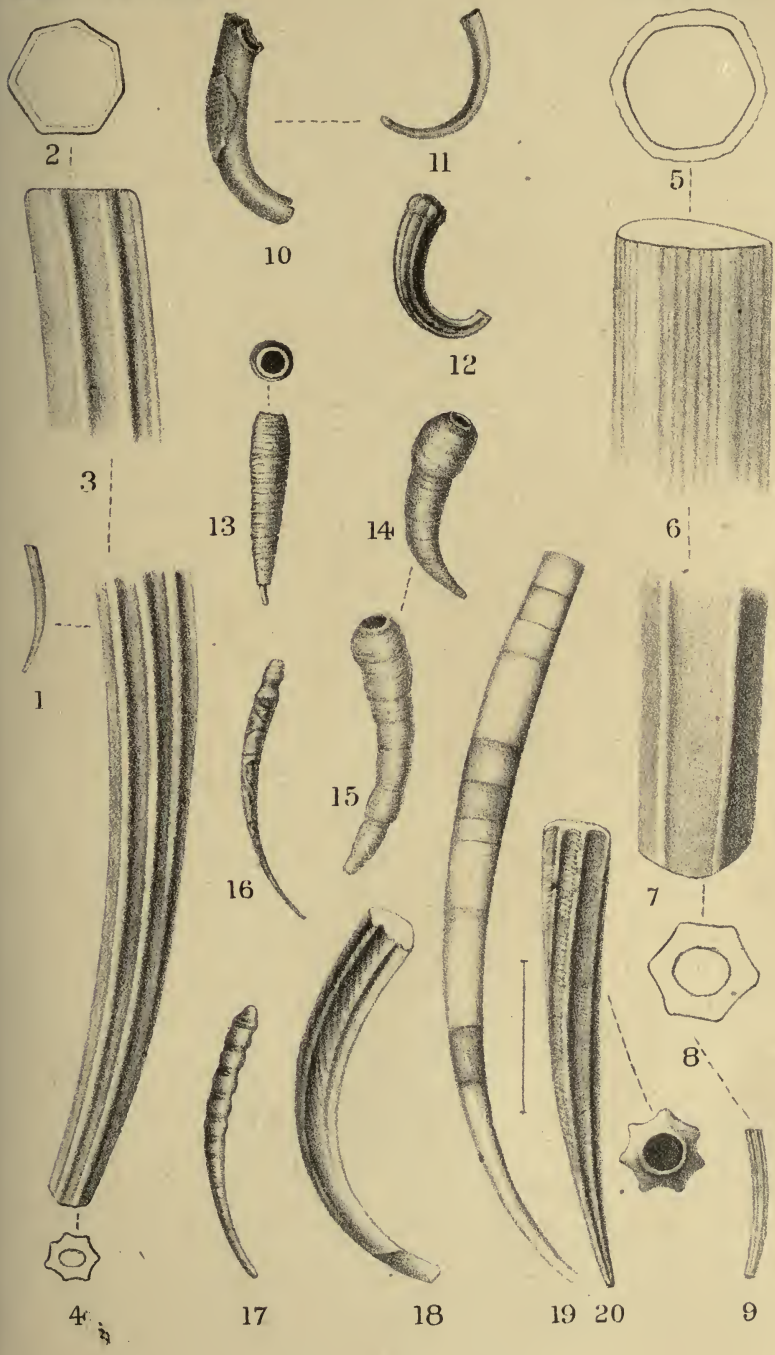
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PREFACE.

The Scaphopoda have hitherto received comparatively little attention from either conchological or morphological naturalists. No other molluscan group of like rank and extent exists upon which the anatomical data are so scanty, or restricted to so small a number of species; and as the Class consists mainly of deep sea dwellers, the list of species now known is doubtless a mere fraction of the grand total of living forms.

Consonant with the general plan of the "Manual," this volume treats primarily of the "system" of Scaphopods, and the determination of genera and species. A classification of the *Dentaliidæ* based upon features hitherto untried for this purpose is submitted; and the innovation is made of including a catalogue of fossil species, largely with a view to rectify the current nomenclature and prevent future complications by the duplication of specific names. The labor of collating the references to fossil forms has been, in large measure, accomplished by Dr. Benj. Sharp.

The work is based upon the collection of the Academy of Natural Sciences, containing a large proportion of known shore species, and upon that of the United States National Museum, including the types of DALL, JEFFREYS, VERRILL and GOULD.

This great collection, undoubtedly richer than any other in existence in deep sea forms, was, with generosity rarely equalled, placed at my disposal by Prof. William H. Dall, Honorary Curator, and the authorities of the Museum. My most earnest thanks are due to them for this and other courtesies.

The published works of Dall, Watson and Jeffreys have been freely quoted herein; and it is to the critical acumen and large experience of these masters of conchological science, transplanted to our pages, that much of their value is due.

An account of the *Aplacophora* is also included in this volume, partly for the sake of greater completeness, partly to call the attention of conchologists to this important group, which has doubtless been neglected by many who have opportunities for collecting.

And now it remains to announce the completion of the *First Series* of the MANUAL OF CONCHOLOGY, with the present volume. Twenty years have passed since the first number appeared in 1878; my able predecessor conducting the work until 1888, as far as the middle of the tenth volume. During the decade of swiftly running years since then, the work has fallen to me. And while an author cannot but feel regret—that what he has done is not better—that long and pleasant relations must suffer interruption—it is still a great pleasure to acknowledge gratitude for numberless acts of generosity from conchologists, for the kindly appreciation of good work and the more kind charity for mistakes, which have rose-bestrewn the difficult path of science. *H. A. P.*

MANUAL OF CONCHOLOGY.

Class SCAPHOPODA.

Cirrhobranchiata Blainville, Man. de Malacol. et Conchyl., p. 495 (1825–1832).

Lateribranchiata Clark, Ann. Mag. N. H. (2) vii, pp. 471, 476 (1851).

"*Solenoconches*" Lacaze-Duthiers; *Solenoconchæ* and *Solenoconchia* of various authors.

Prosopocephala Bronn, Klassen u. Ordnungen des Thier-Reichs, Malacozoa, p. 523 (1862).

Scaphopoda Bronn, *t. c.*, p. 524 (1862).

Bilaterally symmetrical mollusks with the shell (and mantle) a long, more or less curved and tapering or fusiform tube, open at both ends, the concave side dorsal; anterior orifice larger, contracted by a muscular thickening of the mantle, and giving egress to the cylindrical head and the long, pointed foot, which is capable of being enlarged and variously modified in shape distally; the smaller (posterior) orifice of mantle and shell giving exit to the refuse of digestion, respiration and the genital products. Head with terminal mouth surrounded by a rosette of lobes; no eyes; otocysts present; no tentacles, but a close cluster of thread-like, distally enlarged appendages known as *captacula* springs from the base of the snout. Jaw and radula present; liver two-lobed, symmetrical; gut strongly convoluted, the anus opening rather far forward in the mantle cavity, kidney openings near it. Gonad simple, opening through the right nephridium. No gills, respiration being performed by the general integument. Heart rudimentary, with only one chamber, auricles and reno-pericardial ducts wanting. Nervous system with well-developed ganglia, the cerebral, pleural, pedal, visceral and buccal ganglia symmetrical.

Marine animals, living partially imbedded in sand or mud on the sea bottom.

The tubular shell, open at both ends, is characteristic of the group, and occurs nowhere else in the mollusca. Growth takes

place at the larger end and on the inside of the tube, and at the same time the shell is absorbed at a slower rate from the smaller end. The slits and notches in this end are therefore formed by absorption, being wholly different in genesis from similar structures of the peristome in Gastropods. In some forms (pl. 9, fig. 51; pl. 14, figs. 20, 21; pl. 18, fig. 4, 8) upon the practical cessation of growth and absorption upon the attainment of maturity, there is a supplementary tube built out from the edge of the anal orifice. This structure is wholly different from the interrupted "sheath" of very frequent occurrence (pl. 18, fig. 16, 17) which is due to the slower absorption of the dense inner layer of the shell.

The shell contains a very slight organic basis, leaving no appreciable amount when dissolved in acid. It is formed of three distinct layers. The inner layer (*hypostracum*, pl. 38, fig. 3, *h*) is composed of long prisms, rounded at the angles and tapering at the ends. This layer is thinnest at the aperture, thickest toward the apex. The thick middle layer (*ostracum*, pl. 38, fig. 3, *o*) is built up of short prisms in bundles lying at right angles with each other. The outer layer (*periostracum*, pl. 38, fig. 3, *p*) is thin and wholly structureless. It covers the sculpture, ribs, etc., of the shell.

The snout or proboscis shows considerable variation in form, as well as in the number and presence of mouth-lobes in the several species and genera. At its base, there are two plate-like folds of the integument, which bear numerous, long, extensile filaments, each terminating in a spoon-shaped expansion. These "captacula" are prehensile, catching foraminifera, etc., upon which the Scaphopod feeds (pl. 38, fig. 6, one captacle greatly enlarged).

The foot is inserted immediately adjacent to the head, ventrally. In *Dentalium* the foot is pointed, with a circular "epipodial" ridge, interrupted dorsally, some distance from the end, which gives it a trifid or *fleur-de-lis* shape. In the *Siphonodentaliidæ* the "epipodium" is subterminal, not interrupted dorsally, and forms a disk with crenate edge, with or without a central filament representing the conic point of the *Dentalium* foot. It would seem that this expanded disk (as shown on pl. 24) is capable of contraction to a slender conic form (pl. 26, fig. 79); burrowing being effected as in *Solen*, etc., by thrusting the conic foot downward, then expanding it distally for an anchor, and pulling the shell down by contraction of the foot retractor; the process being then repeated.

The gut (pl. 38, figs. 4, 5) is short, closely convoluted. Liver (pl. 38, fig. 1, 2, *l*) large, lying along the ventral side.

The radula (pl. 39, figs. 8, 9) is short, nearly rigid and curved, and incapable of being used as a rasping organ as in other mollusks. Its function is probably largely as a crushing plate, like the "gizzard-plates" of Tectibranchs.

The dentition of the *Scaphopoda*, so far as known, does not show great diversity. The formula of teeth is 1.1.1.1.1. The median tooth is always a nearly flat plate, which in *Dentalium* is much wider than long, in *Entalina* is but little wider than long, and in *Cadulus* and *Siphonodentalium* is longer than wide. The single lateral on each side has an erect, rather shovel-shaped cusp, with several denticles. In *Dentalium* these denticles are short and inconspicuous; in the other genera *Entalina*, *Siphonodentalium* and *Cadulus* there are two or three stout and distinct denticles. The uncini, one on each side, are trapezoidal flat plates, thickened toward their inner edges.

Dentalium.—No species of the typical group or subgenus has been examined anatomically. In the subgenus *Antalis* the dentition of *vulgare* (tarentinum), *entalis* and *occidentale* ("*striolata*" Sars) is known. See pl. 39, fig. 6, *D. occidentale* Stimp.

In *Fissidentalium* the radulæ of *D. megathyris*, *plurifissuratum* and *magnificum* have been examined, and are said to agree with *Antalis*. In *Rhabdus* I find some divergence in the laterals, the cusp being rather strongly bidentate (pl. 39, fig. 5, *D. rectius* Cpr.).

It will be noticed that with the exception of the species last mentioned, the forms yet examined belong to two very closely allied subgenera. When some of the more divergent groups, such as *Bathoxiphus*, *Episiphon* and *Fustiaria*, are examined, it is likely that further modifications will be found. The examination of some species of *Compressidens* is especially to be desired, as that group may prove to belong to the *Siphonodentaliidæ*, in which case it will probably be ranked as a subgenus of *Siphonodentalium*.

Entalina.—The teeth of *E. quinquangularis* have been examined by G. O. Sars (pl. 39, fig. 10). The rhachidian teeth are wider than in other known *Siphonodentaliidæ*, but narrower than in *Dentalium*. The laterals are strongly dentate.

Siphonodentalium.—G. O. Sars has figured the radulæ of *S. lobatum* (*vitreum*) and *S. lofotense*. The rhachidian teeth are as long as wide or longer, and somewhat pentagonal. Laterals strongly tridentate. Pl. 39, figs. 7, 8, 9, *S. lobatum*.

Cadulus.—The dentition of *C. propinquus* is figured by G. O. Sars (pl. 39, fig. 11). It is similar to that of *Siphonodentalium*. For

further anatomical details and embryology, the reader is referred to the papers of Lacaze-Duthiers, Plate, Kowalevski and others, or to the excellent *resumé* by Simroth in Bronn's "Klassen und Ordnungen."

CHANGES OF THE SHELL WITH GROWTH AND AGE, ETC.

The Scaphopods are like *Cæcum, Rumina, Cylindrella* and many other Gastropods in successively truncating the shell posteriorly as growth proceeds at the anterior end. The original apex is retained only in extremely young individuals. This successive truncation is necessitated not only by the excessive fragility of the early portion, which would prevent its retention in any case, but by the necessity for a larger anal orifice as the amount of water with its load of impurities increases with the size of the animal.

The loss of shell substance is due occasionally to accidental breakage, largely to chemical erosion by the water, but constantly to absorption by the mantle of the animal itself, such as occurs internally in *Neritidæ* and externally in roughly sculptured gastropods generally. These several causes, acting in varying combinations, produce an extraordinary variety of forms, even among individuals of a single species. The principal modifications are here tabulated:—

I. Apex simple, the orifice without slit, notch or tube (figures on plate 22).

II. Apex with an supplemental tube, built out. No notch or slit (pl. 18, figs. 4, 8).

III. Apex with a V-shaped notch on the convex side, the orifice usually surrounded by a short sheath formed of the inner layer or lining of the shell left standing after erosion of the prismatic layer outside of it (pl. 18, figs. 11, 16, 17).

IV. Apex with a long, narrow slit on the convex side (pl. 6, figs. 78, 79).

V. A very long, straight linear slit on the convex side (pl. 19, figs. 13, 21).

VI. Slit on the concave face or on the side of the shell. *Heteroschisma* (p. 61), and occasional species or even specimens of other groups, such as *D. sericatum, inversum, alloschismum, exdispar, pretiosum*, etc., have the slit in an abnormal position. The other characters of these forms show them to belong to various diverse groups.

VII. Slit divided into a series of fissures (pl. 6, figs. 87, 89). In *D.* (*Schizodentalium*) *plurifissuratum, D. exuberans* and *D.*

capillosum (pl. 8, fig. 34) this condition occurs either normally or in exceptional cases. All of them agree in other characters with the subgenus *Fissidentalium*, and are herein referred to that group.

VIII. Two symmetrical lateral slits (pl. 27, figs. 90–92).

IX. Four or more slits cutting the apical margin into lobes (plates 28, 29, 30).

These characters have been considered sufficient for the definition of genera by Stoliczka and some other authors. Dall, on the other hand, (Trans. Wagner Inst., iii, 436), attaches no systematic importance to the various modifications, which he attributes largely to erosion and repair of breakage. Neither of these positions seem to us tenable in the radical sense in which they have been advanced. The apical characters are subject to much variation in many species, but they still have considerable value as specific and group characters. It is no valid argument against the systematic value of the apical teeth in (for instance) *Polyschides*, to show that they are frequently broken off, although that argument might be held conclusive against using the character as absolutely diagnostic in the determination of species or genera. Again, the accessory tube, described in paragraph II above, is not due to repair of an accidental breakage, but is a normal process following absorption of the shell, and occurring only in the species of certain subgenera of *Dentalium*, although not developed in every specimen of these species, and occasionally in but a small proportion of them. The forms possessing this structure are not "especially liable to such breakages" more than others which never develop the added tube. The theory that "from a peculiar fragility or liability to transverse breakage in a species, this condition may [become] almost habitual with the adults of that species" is not supported by any evidence we have encountered; and the supporting statement that "no one has ever recorded a specimen with the posterior end entirely unbroken and yet possessing the supplementary tubule," loses its weight when it is remembered that no Scaphopod can in the nature of things retain "the posterior end entirely unbroken" beyond the earliest stages of growth, the absorption of this end being as essential a process as growth at the other.

While we do not consider the characters of the posterior orifice as so unreliable as some authors have thought, it must not be gathered that we place great weight upon them. That there is a wide range of variation among individuals of the same species is sufficiently

shown in the descriptive portion of this work. That apical characters usually cannot be held sufficient for generic and subgeneric distinctions is recognized by our use of other features, especially sculpture, for this purpose. And on the whole, while we cannot endorse all the arguments advanced by Dall to support the position, we thoroughly agree with his conclusion "abnormalities may usually be discriminated by comparison with numerous specimens of the same species. In cases where the student has only one or two specimens, he should refrain from putting reliance on characters which may be abnormal as a basis for describing new forms or for discriminating old ones."

In many species, especially the groups of *D. entalis* and *D. semistriatum*, the young shell is sculptured while the later growth is smooth. Frequently the adult retains some of the sculptured portion posteriorly; but in some individuals or species this early sculpture is entirely lost by posterior truncation. Such forms are practically indistinguishable from species which are without sculpture at all stages of growth, although belonging to quite different groups. Young or half-grown specimens show the true relationships in these cases.

Spurious Scaphopods.

Throughout the early period, various Gastropod mollusks such as *Cœcum* were occasionally described as *Dentalium;* and until Berkeley defined the genus *Ditrupa* in 1834, demonstrating its Vermian nature, the calcareous tubes of species of this genus and of *Pomatoceras* were commonly referred to *Dentalium.* Palæontologists, however, almost up to the present decade, have described the tubes of worms of the family *Serpulidæ* as Scaphopods. So general has been this error, and so widely is it spread throughout the literature of Scaphopoda, that we have considered the pseudo dentalia in a separate section (page 240) of this volume.

Habits, Food, and Use by Man.

According to Lacaze-Duthiers, the Mediterranean *Dentalium* prefers to live in clean and rather coarse sand, and avoids mud containing decomposition products. Many deep sea forms live in mud.

The animal lives buried at an angle of 45° or less with the surface, the posterior end only projecting. Their food consists of foraminifera, minute bivalves, and, it is said, infusoria. The principal enemies of Scaphopods seem to be molluscan. They have been found in the stomachs of *Scaphander* and other opisthobranchs, and

occasionally, though rarely, shells are found bored by rapacious gastropods.

Only in a few places have Scaphopods been utilized by man. The aborigines of the Pacific coast used *Dentalium pretiosum* for currency and also for personal adornment. *D. lessoni* seems to be used for ornament by the natives of New Guinea; and there are probably other like instances among primitive peoples.

LITERATURE OF SCAPHOPODA.

All that has been written about Scaphopoda from the systematic standpoint may be divided into two parts: First, a period of more or less crude and largely unsystematic attempts to define species, beginning with ALDROVANDUS, continued by LINNÆUS, SCHROETER, CHEMNITZ, GMELIN and LAMARCK, and second, the period of more fundamental knowledge of the biologic relations of the group, and exact specific definition inaugurated by DESHAYES.

In like manner, the work of Lacaze-Duthiers upon the anatomy and embryology of the Scaphopoda, subdivides the second period into an older and a modern division.

1758. Linnæus, in the Tenth Edition of the *Systema Naturæ*, places *Dentalium* between the genera *Patella* and *Serpula*. Four species, *elephantinum*, *dentalis*, *entalis* and *minutu* [*m*] are described. In the Twelfth Edition, *aprinum*, *corneum*, *politum* and *eburneum* are added.

In the Thirteenth Edition, Gmelin increase the number to 21, mainly by the addition of fossil species described by Schroeter. With inconsiderable additions to the roll of species, the genus remained without thorough treatment until.

1818. Lamarck, in vol. V of the *Animaux sans Vertèbres*, pp. 341–346, monographed it, recognizing 21 species, several being new. He places the genus among the "Annelides sédentaires," and includes a number of worm-tubes in *Dentalium*. Part of Gmelin's species are omitted, probably as unidentified. A grouping into striated and ribbed species is made.

The next work upon *Dentalium*, passing over that of DeFrance in Dictionaire des Sciences Naturelles, 1819, mainly a complication, is:

1825. Deshayes, *Anatomie et Monographie du Genre Dentale*, in Mémoires de la Société d'Histoire Naturelle de Paris, ii, pp. 321–378. In this essay the systematic study of these animals was established as a science. While before they had been placed indifferently

among either worms or shell fish, Deshayes demonstrated their molluscan organization; where before insufficient specific definitions had been the rule, Deshayes gave full and lucid diagnoses and good figures. He was cognizant of the variations of the apical orifice, and used these features in combination with the sculptural variations for a classification of the species, the number of which was materially augmented.

Deshayes' monograph was translated into English by G. B. Sowerby, who published it in the Zoological Journal, iv, pp. 175–195 (1828), following the descriptions by judicious critical notes.

Substantially the same matter appeared in the second edition of Lamarck, and of the Encyclopedie Méthodique.

1842. Chenu, *Illustrations Conchyliologiques*, Vol. I, *Dentalium*, 8 pages, 7 plates.

Both recent and fossil species are treated, 31 of the 91 species being living Dentalia. Several of the others are worm tubes, and there is one *Cadulus*. The descriptions are extremely brief, the localities often lacking or incorrect, and the figures though good are rather stiff. The work is supposed to illustrate the Paris Museum and Delessert's collection, but the types of numerous species, such as *abbreviatum*, *novemcostatum*, *semialternans*, *virginianum*, *americanum*, *alternans*, *fasciatum*, *philippii*, *ensiforme*, *cylindricum*, *novum*, *dacostianum*, *sowerbyi*, are lacking in these collections, according to a MS. note by Deshayes, written about 1870.

1856–1857. Lacaze-Duthiers, *Histoire de l'organisation et du développement du Dentale*, in Annales des Sciences Naturelles (4), Zoologie, vi, vii. The first accurate and thorough account of the macroscopic anatomy of *Dentalium*, with extended and valuable observations upon the embryology, formation of the primitive shell, etc., is given in this paper, which remains to this day the chief source of information upon the general anatomy of the genus.

1861. M. Sars published an excellent paper upon *Siphonodentalium* (Om *S. vitreum*, en ny Slægt og Art of Dentalidernes Familie), first directing attention to the structure of the foot in this group, with other valuable observations.

1860. G. B. Sowerby, Jr., *Thesaurus Conchyliorum*, Volume III, pp. 97 to 104, pls. 223 to 225. A monograph of the recent species of the genus *Dentalium*. Eighty-five specific names appear, of which 49 pertain to valid species, 5 are considered synonyms, 17 are mentioned as fossil species, and 15 forms unidentified or excluded from the genus. No subdivision of the genus is

attempted, but a general sequence from smooth to ribbed forms is followed. This is the first monograph from which non-molluscan dentaloid forms are rigidly eliminated. The figures are excellent; and the main criticism we would make upon the text is that there is not enough of it. A few species of earlier authors are incorrectly identified, and those unknown in English collections are omitted; but these blemishes are traceable to the general condition of conchology and the condensed plan of the *Thesaurus*, rather than to any lack of care on the part of the author, whose work on *Dentalium* has been of very great value to all subsequent workers.

1872. Much of the same matter, and copies of the same figures were incorporated by Mr. Sowerby in his monograph of the genus in the *Conchologia Iconica*, Volume XVIII, pls. 1–7, with the same number of leaves of text. A few additional species are figured, but the lithographic plates are poor, doing but scant credit to Mr. Sowerby's pencil.

1880–1895. Numerous contributions to the general morphology, histology and embryology of Scaphopoda have appeared since 1880. The more extensive and important memoirs being mentioned below. During the same period two extensive reports upon deep sea Scaphopods appeared:

1886. R. Boog Watson, Challenger Rep., Vol. xv, pp. 1–24. 28 new species are described and figured, and a number of those described by Jeffreys and others are further elucidated.

1889. Wm. H. Dall, Blake Rep., pp. 418–432. 22 new forms are described, with valuable notes on some of the previously known species. In Trans. Wagner Free Institute of Science, iii, pp. 435–446, the American Tertiary species are discussed; further information is given on some living forms, and the value of conchological characters in classification is considered at some length.

1883. A. Kowalevski, Etude sur l'embryogénie du Dentale. Ann. Mus. d'Hist. Nat. Marseille, I.

1885. H. Fol, Sur l'anatomie microscopique du Dentale, in Arch. Zool. Expér. et Génér. (2), vii, pp. 91–148.

1892. L. Plate, Ueber den Bau und die Verwandtschaftsbeziehungen der Solenoconchen. Zool. Jahr., Abth. für Anat. u. Ontog., v, p. 301–386.

1892. P. Pelseneer, La Classification générale des Mollusques. Bull. Scient. France et Belg., xxiv.

1891–1894. C. Grobben, Verhandl. der d. zool. Ges., 1891, p. 63; also Sitzber. k. Akad. Wiss., Wien, 1894, p. 61.

1895. H. Simroth, Scaphopoda, in Bronn's Klassen und Ordnungen des Thier-Reichs, new edition, Vol. iii, pp. 356–467. This contains the best recent general account of the anatomy and ontogeny of the class, and includes a bibliography of papers upon these subjects.

1896. S. Clessin in the *Systematisches Conchylien-Cabinet*, IV, Abth. 5, Heft x, Lieferungen 422, 424, pp. 1–48, pl. 1–11, gives a monograph of *Scaphopoda* which is not only one of the worst monographs in that justly famous series, but perhaps the most ineffective example of monographic work to be found in modern conchological literature. Purporting to cover the genera *Dentalium*, *Antalis*, *Siphonodentalis* (blunder for *Siphonoentalis*), *Siphonodentalium*, *Cadulus*, *Dischides* and *Gadus*, it is not only extremely incomplete in all of them, but the generic limits are everywhere singularly misunderstood. Thus "Dentalium" actually contains species of nearly all the other genera admitted, etc., etc. Most of the figures and descriptions are copied from the *Conchologia Iconica*, and credited to Reeve instead of Sowerby. The synonymy is often hopelessly muddled, and all borrowed. The author does not seem to have actually seen more than a half dozen species; and of the three "new species" described, one is a worm tube, another probably not distinct from *D. rubescens* Dh., and the third an absolute synonym of *D. pretiosum* Nutt. Clessin apparently had neither the monographs of Deshayes or Chenu before him, and the important works of Watson on the 'Challenger,' and Dall on the 'Blake' Scaphopoda were unknown to him. Several specific names are misspelled.

See table on next page for summary.

Distribution of Scaphopoda.

The Scaphopods are in no respect remarkable or anomalous in distribution, as compared with Gastropod or Pelecypod mollusks. So many species belong to the deep sea fauna that the lists of species under the conventional "Provinces" are somewhat misleading, comprising a shore element with species having the range and limitations of the shore fauna generally, and a deep water element with more widely distributed species, frequently common to two or more of the provinces defined by shore mollusks. It is the prevalence of deep water forms which swells the list of North Atlantic and Gulf of Mexico species to large proportions compared to Indo-Pacific regions. The latter are as yet almost untouched by the dredge.

Table showing number of species included in the principal monographic works on Scaphopoda.

		Lamarck, 1818.	Deshayes, 1825.	Chenu, 1842.	Sowerby, 1860.	Sowerby, 1872.	Clessin, 1896.	Pilsbry & Sharp, 1898.
Dentaliidæ	Recent species.	10	18	30	47	52	48	158
	Fossil species.	8	19	48	17	0	0	303
	New species or new names.	10	19	21	17	1	3	55
Siphonodentaliidæ	Recent species.	0	0	0	2	3	16	80
	Fossil species.	0	1	0	0	0	0	51
	New species or new names.	0	0	0	1	0	0	20
Worms, etc., described as Scaphopods.		3	4	12	0	0	1	0
Total number of specific names, including synonyms.		23	55	93	85	62	100	1013

Note.—The number of new species in each work is, of course, taken at the author's estimate. It is really less in most cases, part proving to be synonyms.

The genera are practically universal in distribution; but the subgenera *Fissidentalium, Heteroschisma, Bathoxiphus, Rhabdus, Episiphon* and *Compressidens* are almost exclusively deep water forms. Typical *Dentalium, Antalis* and *Graptacme* are mainly shore groups. The subgenera are more or less localized, though not nearly to the same extent as groups of like rank in the Gastropoda or Polyplacophora.

The bathymetric range of Scaphopods is considerable, but as data thereon are abundantly given in the text, no examples need be cited here.

Eastern Atlantic and Mediterranean.

Species marked with an asterisk in the list following occur also in the Western Atlantic or Gulf of Mexico. With the exception of *D. entalis,* which is a shore form having the northern distribution

of so many species, all of the Scaphopods common to East and West Atlantic are essentially deep water species. The *Antalis* group is largely special to European seas, having but few West Atlantic representatives. The polygonal typical Dentalia, and the subgenera *Graptacme* and *Compressidens*, are West Atlantic groups not represented in the Eastern Atlantic or Mediterranean. The *Polyschides* group of *Cadulus*, well represented in the earlier Tertiary, has not yet occurred in the recent northeastern Atlantic fauna.

D. vulgare, p. 41, 0–543 fms.
*D. entalis, p. 42, 3–1,750 fms.
*D. agile, p. 46, 400–1,785 fms.
*D. occidentale, p. 47, 50–1000.
D. ænigmaticum, p. 49,640–1000.
D. novemcostatum, p. 51.
D. inæquicostatum, p. 52.
D. dentalis, p. 53.
D. panormum, p. 54, 0–195 fms.
D. senegalense, p. 55.
D. concinnum, p. 250, 150 fms.
(*Fissidentalium*).
D. milneëdwardsi, p. 75, 800.
D. semivestitum, p. 75, 500.
D. exuberans, p. 78, 700–2,062.
D. ergasticum, p. 74, 226–1,073.
D. scamnatum, p. 79, 700 fms.
*D. candidum, p. 72, 410–1,750.
*D. capillosum, p. 77, 100–1,785.
D. rectum, p. 252, deep sea.
(*Lævidentalium*, etc.)
D. caudani, p. 104, 730 fms.
D. rubescens, p. 105, 2–40 fms.
D. siculum, p. 107.
D. tenuifissum, p. 129.
(*Episiphon.*)
*D. filum, p. 118.
(*Bathoxiphus.*)
*D. ensiculus, p. 121.
(*Heteroschisma.*)
*D. subterfissum, p. 61.

Entalina quinquangularis, p. 132
*Siphonodentalium lobatum.
*S. lofotense, p. 138.
S. teres, p. 138.
*S. affine, p. 140.
S. pusillum, p. 140.
Cadulus (Dischides) politus.
C. ovulum, p. 156.
C. cyathus, p. 156.
*C. amphora, p. 161.
C. subfusiformis, p. 163.
C. gibbus, p. 159.
*C. tumidosus, p. 160.
*C. jeffreysi, p. 164.
*C. gracilis, p. 165.
C. propinquus, p. 166.
C. cylindratus, p. 166.
C. senegalensis, p. 176.
C. strangulatus, p. 176.
C. monterosatoi, p. 177.
C. artatus, p. 177.

Western Atlantic and Gulf of Mexico.

About 66 species, equally divided between the families *Dentaliidæ* and *Siphonodentaliidæ* are known; 15, or about 23 per cent, are common to the East and West Atlantic. The typical Dentalia of

D. octangulatum group, the subgenera *Graptacme*, *Compressidens*, *Polyschides*, and the *Cadulus acus* group, are forms which this region has in common with the Panamic province, but which are wanting in the Eastern Atlantic thus far. The list of species common to both sides of the Atlantic will probably be increased ; but still the affinity of West Atlantic and especially the Gulf of Mexico Scaphopod fauna with that of the Panamic region, is upon the whole as fundamental as that between the two sides of the Atlantic.

D. laqueatum, p. 10.
D. gouldii, p. 20, 247.
D. picteti, p. 22.
D. carduus, p. 30.
(*Antalis.*)
D. disparile, p. 56.
D. ceratum, p. 57.
D. antillarum, p. 57.
D. taphrium, p. 58.
*D. entalis, p. 42.
*D. agile, p. 46.
*D. occidentale, p. 47.
(*Heteroschisma.*)
*D. subterfissum, p. 61.
D. callithrix, p. 62.
(*Fissidentalium.*)
D. amphialum, p. 71.
*D. candidum, p. 72.
*D. capillosum, p. 77.
(*Graptacme.*)
D. sericatum, p. 86.
D. eboreum, p. 89.
D. leptum, p. 89.
D. semistriatum, p. 90.
D. circumcinctum, p. 88.
D. calamus, p. 97.
(*Lævidentalium.*)
D. callipeplum, p. 100.
D. ensiforme, p. 101.
D. perlongum, p. 104.
D. matara, p. 105.
D. liodon, p. 107.
(*Episiphon.*)
D. sowerbyi, p. 117.
*D. filum, p. 118.
(*Bathoxiphus.*)
*D. ensiculus, p. 121.
(*Compressidens.*)
D. pressum, p. 124.
D. ophiodon, p. 126.
(*Fustiaria.*)
D. stenoschizum, p. 128.

Entalina platamodes, p. 133.
*Siphonodentalium lobatum.
S. tytthum, p. 137.
*S. lofotense, p. 138.
*S. affine, p. 140.
Cadulus (Polyschides) tetraschistus, 148.
C. (P.) tetrodon, p. 151.
C. (P.) carolinensis, p. 152.
C (P.) bushii, p. 153.
C. (P.) spectabilis, p. 153.
*C. amphora, p. 161.
*C. jeffreysi, p. 164.
*C. gracilis, p. 165.
C. minusculus, p. 164.
C. lunula, p. 167.
C. watsoni, p. 167.
C. rushii, p. 168.
C. agassizi, p. 168.
C. hatterasensis, p. 169.
C. poculum, p. 170.
C. vulpidens, p. 170.

C. (P.) grandis, p. 154.
C. ampullaceus, p. 158.
C. exiguus, p. 159.
C. obesus, p. 159.
*C. tumidosus, p. 160.
C. curcurbita, p. 161.
C. sauridens, p. 171.
C. amiantis, p. 174.
C. rastridens, p. 174.
C. curtus, p. 175.
C. acus, p. 191.
C. dominguensis, p. 191.

Panamic province—Ecuador to Lower California.

Fourteen species of *Dentalium* and six of *Cadulus* are known, five of the former genus, four of the latter having occurred only in depths greater than 300 fms. The rest are shore species, all of them probably to be found living within the 25 fathom line. *D. tesseragonum*, *quadrangulare*, *semipolitum*, *sectum*, *innumerabile* and *brevicornu*, and *Cadulus perpusillus* and *panamensis* have their nearest allies in the Antillean Tertiary and recent faunas; some of them being at most only varietally distinct from their West Indian counterparts. *D. æquatorium* and *dalli* and *Cadulus albicomatus* and *striatus* are essentially West American types, having no near allies in Antillean or Oriental seas. In general, the deep water Panamic Scaphopods belong mainly to what seem to be endemic West American groups of species, while the shore or shallow water species are very intimately related to Antillean forms.

Dentalium oerstedi
D. agassizi, 322–1,020 fms.
D. tesseragonum.
D. quadrangulare.
D. fisheri.
D. megathyris, 812–2,282 fms.
D. semipolitum.
D. inversum.
D. splendidum.
D. sectum.
D. æquatorium, 401 fms.
D. dalli, 660 fms.
D. innumerabile.
D. brevicornu, 634–995 fms.

Cadulus striatus, 322 fms.
C. albicomatus, 401–1,672 fms.
C. platystoma, 401 fms.
C. californicus, 1,270 fms.
C. perpusillus, p. 190.
C. panamensis, p. 191.

Key to Panamic species of Dentalium.

a. Shell square at apex, keeled on dorsal, ventral and lateral faces.
b. Smooth and rounded toward aperture; length 20 mill., 8 times the diam., *tesseragonum*, p. 34.
b'. Interstices striated throughout.
c. Length 20 mill., 5⅓ times the diam., *quadrangulare*, p. 35.

c'. Length 14–15 mill., nearly 8 times the diam., *fisheri*, p. 36.

a'. Shell longitudinally ribbed.

b. 6-ribbed at apex, increasing to 12, and at aperture with 17–24 alternating riblets; length 27 mill., about 9 times the diam., *oerstedi*, p. 24.

b'. Similar, but glossy with finer sculpture and more numerous riblets at aperture, var. *numerosum*, p. 25.

b''. 12 to 20 sharp riblets at apex, 25–48 at aperture, the interstices wider than ribs, concave; length 29–65 mill., 9 to 15 times the diam., *agassizi*, p. 26.

b'''. About 50 riblets and threads; shell very large, strong and solid; aperture oblique; length 90–99 mill., 5 to 5½ times the diam., *megathyris*, p. 67.

a''. Shell with fine, evenly engraved longitudinal striæ toward the apex or throughout; section circular.

b. Apex with a straight, narrow slit across an obliquely conic, smooth plug; shell cylindrical; length 24 mill., 15 times the diam., *sectum*, p. 96.

b'. Apex with slit on concave side; shell translucent whitish with opaque rings; length 30 mill., 16 times the diam., *inversum*, p. 95.

b''. Apex simple; length 25–30 mill., 10 times the diam. *semipolitum*, p. 91.

a'''. Shell without longitudinal sculpture, rounded or oval in section.

b. Strongly compressed between convex and concave faces, rapidly tapering; length 9·5 mill., about 4 times the diam. *brevicornu*, p. 125.

b'. Shell compressed laterally, excessively slender, fragile, salmon tinted; length 17, greatest diam. 0·8 mill. *innumerabile*, p. 119.

b''. Shell subcircular in section.

c. Well curved, polished, flesh-tinted toward the apex, which is sometimes slit in front and behind; length 45 mill., 12 times the diam. *splendidulum*, p. 96.

c'. Curvature very slight; thin, white, smooth.

d. Almost perfectly straight, fragile, excessively slender; length 31 mill., nearly 20 times the diam., *æquatorium*, p. 112.

d'. Less straight, decidedly wider; length 45–69 mill., 11–14 times the diam., *dalli*, p. 114.

Peruvian Province.

The west coast of South America from Peru southward is not known to possess any shore Scaphopods; the few species known from off Chili are deep water forms of the Eastern Pacific, or members of the Magellanic fauna.

Magellanic Province.

The few species yet known belong to widely distributed subgenera. *D. megathyris* extends north to the northern limit of the Panamic fauna.

D. majorinum, p. 27, and var. magellanicum. Magellan St., etc.

D. lebruni, p. 102. Magellan Strait.

D. megathyris, p. 67, off Chiloe I., 1,050–1,342 fms.

C. (Polyschides) dalli, p. 155, west coast Patagonia, 122 fms.

In this connection might also be mentioned *D. ceras*, p. 68, an essentially mid-Pacific species, which has been dredged from 2,160 fms., west of Valparaiso. It is allied to *D. Degathyris*.

California to Alaska.

Eight species of Dentalium are known from this region, two of them, *semipolitum* and *agassizi* being southern forms, reaching the neighborhood of San Diego. *D. neohexagonum* and *D. pretiosum* with its variety *indianorum* are abundant shore species, the others being from deeper water.

Six species of *Cadulus* have been described, mostly within the past year.

The following species extend into the Panamic province: *D. semipolitum, agassizi, dalli, C. californicus.* The subgenus *Rhabdus* is almost peculiar to this and the Panamic region; the affinities of the other species are with Panamic forms, with the exception of *D. pretiosum*, which belongs to *Antalis*, a North Atlantic group.

D. neohexagonum.
D. agassizi, 822 fms.
D. pretiosum.
D. semipolitum.
D. watsoni, 786 fms.
D. rectius, 13–786 fms.
D. dalli, 265–786 fms.
D. stearnsii, 786 fms.

C. (Polyschides) quadrifissatus.
C. californicus, 252–822 fms.
C. tolmiei, 60 fms.
C. aberrans.
C. fusiformis.
C. hepburni, 60 fms.

Key to Californian species of Dentalium.

a. Shell longitudinally strongly ribbed.
b. Ribs typically 6, decreasing anteriorly, *neohexagonum*, p. 19.
b'. Ribs 12–20 at apex, 25–48 at aperture, *agassizi*, p. 26.
a'. Shell longitudinally striate near apex (or in young specimens, throughout).
b. Thin, closely, finely and evenly engraved toward apex, smooth and polished toward aperture; length 25–30 mill., *semipolitum*, p. 91.
b'. Rather solid and opaque; larger; unequally lirulate toward apex, *pretiosum* var. *indianorum*, p. 45.
a''. No longitudinal sculpture.
b. Strong and solid, young striated, *pretiosum*, p. 44.
b'. Quite thin; deep water species; no apical notch.
c. Slender, with very slight curvature, and slow increase.
d. Very slightly curved, very slender; length 30 mill., 16–19 times the diam., *watsoni*, p. 113.
d'. Almost straight, very glossy; length 30–40 mill., 12–15½ times the diam., *rectius*, p. 113.
d''. Curvature regular but slight; length 45 to 69 mill., 11 to 14 times the diam., *dalli*, p. 114.
c'. Short, decidedly curved, very rapidly tapering; tube vertically compressed; length 8·6 mill., 4½ times the greatest diam., *stearnsii*, p. 253.

Japan and China.

Fifteen species of *Dentalium*, none of them deep water forms, are known from this side of the Pacific from Hong Kong northward. Five of these are more or less widely distributed in the East Indies and Indian Ocean, the others being until now known only from Japan and China. The dominant group is that of *D. octangulatum*. There is one *Antalis* and three *Fissidentalium*. Dredging in deeper water will doubtless reveal a rich fauna.

One nameless *Siphonodentalium* (p. 141) is recorded from Corea, and *Cadulus clavatus* (p. 185) occurs in Hong Kong harbor.

Key to Japanese and Chinese Dentalium.

a. Primary ribs 6–13, strong, angulating the aperture; shell white or pale.

b. Ribs 6 (rarely 7), strong, intervals with some riblets generally, length about 55 mill., 12–14 times the diam., *hexagonum* (p. 18); *sexcostatum*, p. 19.

b'. Ribs 7–9, some interstitial riblets.

c. Ribs 7–8; length 72 mill., 12 times the diameter, *japonicum*, p. 17.

c'. Ribs 8–9; length 50 mill., 10 times the diameter, *octangulatum*, p. 16.

c''. Ribs 8–9; length 30 mill., 8 times the diameter, *yokohamense*, p. 16.

b''. Ribs 11–13, strong and narrow; an interstitial thread or none; a wide, shallow apical notch; length 70 mill., 11–12 times the diam., *bisexangulatum*, p. 16.

a'. 16 narrow riblets at apex, increasing to double that number, and then vanishing, the large end smooth except for growth-lines, length 80 mill., 11 times the diam., *weinkauffii*, p. 40.

a''. 6–12 riblets at apex, increasing to about double that number.

b. 6, increasing to 12; shell acute, rapidly widening; length 18 mill., 8–9 times the diam., *intercalatum*, p. 23.

b'. 8 ribs, increasing in number toward aperture; cancellated with growth-striæ; length 25½ mill., about 8 times the diam., *cancellatum*, p. 30.

b''. 12 delicate sulci, increasing to 30; length 20 mill., 8 times the diam., *porcatum*, p. 15.

a'''. 30 sulci, vanishing toward aperture; length 30 mill., 10 times the diam., *buccinulum*, p 14.

a''''. Smooth, glossy, white; longitudinally finely striate at apex, becoming smooth, *aciculum*, p. 93.

a'''''. Riblets very numerous; shell large and solid.

b. About 40 subequal riblets becoming alternating toward apex, where there is a long slit; length 90 mill., 8–9 times the diam., *vernedei*, p. 80.

b'. Many unequal riblets; a series of 2 to 5 holes in place of the slit; length 47 to 64 mill., about 8½ times the diam., *plurifissuratum*, p. 82.

b''. Numerous unequal riblets; tawny, irregularly banded with brown; tube compressed; length 62 to 72 mill., about 6 times the diam., *hungerfordi*, p. 84.

Indo-Pacific Province—East Indies, Philippine Islands, Singapore to N. Papua.

About 20 species of *Dentalium* and two *Cadulus* are reported from definite localities in the "East Indies," nearly all being shallow water species, the deep water forms being still unknown. No doubt many other species recorded from China and Japan, Torres Strait, and the Indian Ocean, also occur here. The specialty of this tract is the group of green colored species.

D. elephantinum.
D. formosum.
D. aprinum.
D. interstriatum.
D. javanum.
D. letsonæ.
D. hexagonum.
D. bisexangulatum.
D. pseudosexagonum.
D. dispar.
D. quadrapicale.
D. variabile.
D. belcheri.
D. acutissimum, 1,070 fms.
D. bisinuatum.
D. longitrorsum.
D. eburneum.
D. philippinarum.
D. subrectum.
Cadulus gadus, p. 186.
C. singaporensis, p. 195.

Key to species of Dentalium.

a. Shell ribbed, decidedly colored, generally green. *Group of D. elephantinum*, p. 1; and of *D. aprinum*, p. 3.

a'. Shell ribbed, white or whitish, not green.

b. Square, with four right angles or keels at apex, becoming rounded at aperture.

c. The four primary ribs bifid or trifid, *dispar*, p. 32.

c'. Primary ribs simple; surface costulate, about 36 riblets at aperture, which is very oblique, *quadrapicale*, p. 34.

b'. Hexagonal or 6-ribbed at apex.

c. 6-ribbed throughout, intervals smooth or with several striæ toward aperture; length 55 mill., 12–14 times the diam. *hexagonum*, p. 18.

c'. Each interval divided and subdivided by successively arising riblets, *pseudosexagonum*, p. 23.

b''. 10–13 ribs, or more.

c. 11–13 ribs throughout, the ribs not dotted; a weak thread in intervals or none, *bisexangulatum*, p. 15.

c'. Ribs dotted or articulated, gray and white, *variabile, belcheri*, p. 60.

a''. No longitudinal sculpture.

b. Much curved throughout; amber, carnelian or white; smooth, glossy, length about 90 mill., about 19 times the diam., *longitrorsum*, p. 111.

b'. Curvature moderate or slight; surface with low variceal swelling or rings; length 50–70 mill., 12 to 15 times the diam., *eburneum*, p. 115; *philippinarum*, p. 116.

b''. Curvature moderate; surface smoothish; apex notched on both convex and concave sides; length 33 mill., 11 times the diam., *bisinuatum*, p. 108.

b'''. Nearly straight, small, fragile and acicular; length 16, diam. of aperture 1 mill., *subrectum*, p. 119.

Indo-Pacific Province—Middle Indian Ocean, etc.

D. quadrapicale, p. 34. Travancore, 406 fms.; Malabar.
D. usitatum, p. 29. Off Ceylon, etc., 597–675 fms.
D. filosum, p. 13. Tenasserim.
D. conspicuum, p. 248. Karachi.
D. politum, p. 128. "Indian Ocean."
D. profundorum, p. 79. Off Colombo, Ceylon, 675 fms.
D. magnificum, p. 251. Off east coast Ceylon, 637–800 fms.
D. lacteum, p. 99. "India."
D. insolitum, p. 109. Bay of Bengal, 597 fms.
Entalina mirifica, p. 134. Off Ceylon, 200–350 fms.
Cadulus anguidens, p. 253. Madras.

Southwestern Indian Ocean.

D. bisexangulatum, p. 15. Querimba Is. and Mozambique.
C. gadus, p. 186.
C. divæ, p. 188. Island of St. Paul.
[D. ægeum, p. 69. Kerguelen I., 110 fms.]

South African.

D. strigatum, p. 13. "D. lessoni Desh." Sowb.

Indo-Pacific Province: Persian Gulf and Red Sea.

Seven species of *Dentalium* are known from this province, only two of which (*longitrorsum* and *aciculum?*) extend far beyond its limits. As most of the others are still unfigured, it is possible that some of them may prove identical with forms described from other regions; but on the other hand there will doubtless prove to be

other species when these rich basins are more fully investigated. See also p. 247.

a. No longitudinal sculpture.

b. Raised growth-striæ near apex; slender, length 22 mill., 11 times the diam., *subtorquatum*, p. 101.

b'. Polished, much curved, extremely long and slender; length 90 mill., about 19 times the diam., *longitrorsum*, p. 111.

a'. Longitudinal striæ near apex, elsewhere smooth, *aciculum*, p. 93.

a''. Longitudinally ribbed.

b. 9 strong ribs and some interstitial riblets; length 40–48 mill., about 7 times the diam., *lineolatum*, p. 11.

b'. 11 indistinct ribs; shell thick, ungraceful; length 44 mill., 8 times the diam., *clavus*, p. 55.

b''. 11–12 ribs, interstices and ribs strongly longitudinally lineated; length 37½ mill., 10 times the diam., *aratorum*, p. 10.

b'''. 14 slightly elevated ribs, intervals flat; length 31 mill., 20 times the diam., *cookei*, p. 29.

b''''. 21 subequal ribs, intervals flat; dense, lamellose growth striæ; length 75 mill., 7 times the diam., *shoplandi*, p. 28.

A single *Cadulus, C. minutus*, p. 188, is described.

Indo-Pacific Province:—Torres Straits, Papua, New Caledonia, etc.

Out of some sixteen species of *Dentalium* recorded from this area, six are widely distributed Indo-Pacific forms. Of the others only two have been figured, and comparisons with a good series of species from other regions would probably develop some synonymy. Still, it is evident that this region has a somewhat special Scaphopod fauna. None of its species are known to extend southward to New South Wales, though they probably follow the Great Barrier Reef of Queensland.

a. Smooth, or with no longitudinal ribs or riblets.

b. Incised spaced circular lines on smaller end, smooth towards aperture; length 14 mill., *anulosum*, p. 101.

b'. No conspicuous circular lines; glossy, strongly curved, very long and slender; length 90 mill., about 19 times the diam., *longitrorsum*, p. 111.

b''. Glassy, very thin, with fine obliquely encircling striæ, and minutely longitudinally scored when young; very slender, *acutissimum*, p. 94.

a'. With four angles toward the square apex.

b. 4 bifid or trifid keels towards apex, with fine riblets between them, becoming cylindrical and polished toward aperture; length 30 mill., *dispar*, p. 32.

b'. A serrate rib at each angle; white, straightened; length 16 mill., 8 times the diam., *quadricostatum*, p. 33.

a''. With 6 to 13 primary ribs, at least on the smaller half of shell. Section not elliptical.

b. 6 ribs at apex, 12 from middle to aperture, the intervals smooth; white; length 22 mill., 11 times the diam., *duodecimcostatum*, p. 13.

b'. 6 ribs at apex, numerous striæ soon appearing in each interval; length 45–50 mill., 11–12 times the diam., *pseudosexagonum*, p. 23.

b''. 7 ribs at apex, with interstitial riblets anteriorly; white; length 14 mill., *katowense* and *cheverti*, p. 9.

b'''. 8 to 10 primary ribs.

c. Ribs 8, prominent, intervals deeply concave, with a few riblets in adults; white; length 50 mill., about 10 times the diam., *octangulatum*, p. 16.

c'. Ribs 8, narrower, intervals wide, flat; tinted; length 48–77 mill., 11–13 times the diam., *javanum*, p. 4.

c''. Ribs 8–10, low, rounded, obsolete at aperture; length 50 mill., 12½ times the diam., *lessoni*, p. 8.

c'''. Ribs 9, rounded, distant, intervals flat; aperture angular; length 20 mill., 8 times the diam., *robustum*, p. 12.

c''''. Ribs 10, rather sharp, intervals nearly flat, transversely striate; thin, white, tapering; length 20 mill., about 7 times the diam., *decemcostatum*, p. 8.

b''''. 11–13 strong narrow ribs, intervals with a weak thread or none; length 70 mill., 11–12 times the diam., *bisexangulatum*, p. 15.

a'''. 16 angular ribs, smaller ones sparsely intercalated below; intervals clathrate; tube elliptical in section, *clathratum*, p. 84.

The *Siphonodentaliidæ* are as follows:

Siphonodentalium eboracense, p. 140.
Cadulus (Dischides) prionotus, p. 146.
Cadulus simillimus, p. 182.
Cadulus ? lævis, p. 195.
Cadulus viperidens, p. 184 (Loyalty Is.).

Pacific species.

Eastward from the region last treated the known species are few, part being shore forms, part deep water species. None of these have occurred elsewhere, and no other species are yet known from this area.

D. diarrhox, p. 109. Northeast from New Zealand, 700 fms.
D. acutissimum, p. 94. North of Papua, 1,070 fms. and mid-Pacific east of Japan, 2,050 fms.
D. tornatum, p. 121. Levuku, Fiji, 12 fms.
D. complexum, p. 76. Off Honolulu, 295 fms.
D. phaneum, p, 59. Off Honolulu, 298–357 fms.
D. ceras, p. 68. Mid-Pacific, east of Japan in 2,050, and west of Valparaiso in 2,160 fms.
Cadulus (Dischides) belcheri, p. 145. North Pacific.
C. (D.) dichelus, p. 145. Levuku, Fiji, 12 fms.
C. honoluluensis, p. 185. Off Honolulu, 40 fms.
C. colubridens, p. 184. Northeast from New Zealand, 700 fms.

Australian Province: New South Wales to South Australia and Tasmania.

Five species of *Dentalium* and one *Cadulus* (*C. acuminatus*, p. 183) are known from this coast, to which a sixth may be added, *D. leptosceles*, from lat. 42° 42′ S., south of Australia, in 2,600 fms. The others are from inconsiderable depths. None of them have occurred elsewhere. The "*D. octagonum*" reported by Angas was apparently an incorrect identification, and *D. novæhollandiæ* has not been found by Australian naturalists.

a. Shell longitudinally ribbed.
  b. Equally 8-ribbed, intervals often subcostate; length 10·5 mill., *tasmaniense*, p. 9.
  b′. Obsoletely equally ribbed; length 10 mill., *weldianum*, p. 9.

b''. Seven-ribbed, the ribs lower and splitting toward aperture; length 19 mill., nearly 7 times the greatest diam., *bednalli*, p. 248.

a'. Minute longitudinal striæ on the smaller end, the rest smooth; length 76 mill., about 18 times the diam., *novæhollandiæ*, p. 93.

a''. No longitudinal sculpture.

b. Length 11 mill., about 9 times the greatest diam.; aperture very oblique, wider than long; surface obliquely wrinkled, *platyceras*, p. 126.

b'. Decidedly larger, more slender, polished, *leptosceles, lubricatum, erectum*, p. 110, 111.

New Zealand.

Five species of *Dentalium* are credited to this province, one of which is a doubtful member of the fauna, and two others of uncertain standing (see synopsis below). All are confined to the province. No *Cadulus* or *Siphonodentalium* have yet come to light.

a. Shell smooth, white, nearly straight; length 15 mill., about 9 times the diam., *ecostatum*, p. 102.

a'. Shell with longitudinal ribs.

b. Principal ribs about 18.

c. Eighteen unequal ribs at aperture, fewer at apex; length 15–16 mill., about 6 times the diam., *huttoni*, p. 71.

c' Eighteen ribs, with intervening riblets, all becoming subobsolete at aperture; shell nearly straight, rapidly tapering; slit short; length 56 mill., about 7½ times the diam., *opacum*, p. 70.

b'. Thirty or many ribs; length 57–60 mill., 7 or 8 times the diam., *zelandicum, pacificum*, p. 70.

Habitat unknown.

The habitats of the following are unknown: *D. curtum, dipsyche, aculeatum, dacostianum, translucidum, ambiguum, longum, fistula* and *multistriatum*. There are also a few others, of which the assigned localities are more or less doubtful.

Geologically the group is an old one. *Dentalium* first appears in the Lower Silurian; though it must be noted that part of the Silurian species, such as some of those described by Eichwald, are very doubtful members of the group, presenting bizarre sculptural char-

acters and unusual forms. In the Carboniferous numerous very large species occur, some of them surpassing any of the recent forms. These belong mostly to the subgenus *Plagioglypta*, a group which became extinct before the close of the Mesozoic.

Families of Scaphopoda.

I. Width of the median tooth of the radula double its height. Foot with an encircling epipodial sheath which is discontinuous, interrupted on the side next to the head. Shell greatest in diameter at the oral opening, DENTALIIDÆ, p. xxix.

II. Width of median tooth much less than double its length, generally less than the length. Foot vermiform, capable of expansion into a terminal or subterminal rosette-like disk, not interrupted dorsally. Shell generally smooth, often inflated, SIPHONODENTALIIDÆ, p. 130.

Family *DENTALIIDÆ*.

Characters given above. A single genus is generally recognized.

Genus DENTALIUM Linné, 1758.

Dentalium L., Syst. Nat. (10), p. 785, and of most subsequent authors.—*Dentalites* Schlotheim, Die Petrefactenkunde, p. 93 (1820), and of Brongniart, Dict. Classique d'Hist. Nat., v, p. 419 (1824), DeFrance, Dict. Sc. Nat., xiii, p. 73 (1819).—*Entalites* Walch., Naturg. Verstein., ii, p. 276 (1768).—*Dentalis* Llwyd., 1698, Lang, 1722, Klein, 1731, and some other pre-Linnean authors.—*Dentalites* Schroeter, Litholog. Lex., i, p. 405 (1779). *Syringites, Canalites, Tubulus* and *Tubulites* of some early authors (see Hermannsen).

The genus *Dentalium*, as herein understood, is co-extensive with the family *Dentaliidæ*. The synonyms cited above are all obsolete, and none of them available for subgeneric groups.

Key to subgenera of Dentalium.

In using the following key, much difficulty will be found in distinguishing *Dentalium* restricted, *Antalis* and *Fissidentalium*. These groups are closely allied, and while natural assemblies, we would scarcely have segregated them as subgenera had they not already been named. Moreover, certain species of *Antalis* and *Graptacme*, when old, have lost the characteristic longitudinal sculpture, and become not readily distinguishable from *Lævidentalium*. The subgenus *Compressidens* (which may prove to belong to *Siphonodental-*

ium) sometimes shows longitudinal riblets, and hence has been included in both divisions of the key. The other subgenera are strongly characterized, natural groups, easily distinguishable in the recent and fossil faunas.

I. *Surface distinctly ribbed or striate longitudinally, at least near the apex.*

a. Five-angled, at least apically, *Entalina*, p. 131.

a^1. Not pentagonal.

b. Apical slit on concave side; coarsely striate or ribbed, *Heteroschisma*, p. 61.

b^1. Close, fine, even, deeply engraved striæ near apex or throughout, section circular or nearly so, white or whitish; mainly rather small, *Graptacme*, p. 85.

b^2. Decidedly polygonal or ribbed, at least near apex; slit short and on convex side, or wanting, *Dentalium s. s.*, p. 1; *Antalis*, p. 37.

b^3. Circular, solid, becoming striate toward apex, which is simple, notched, or with a supplemental tube, *Antalis*, p. 37.

b^4. Large, with many riblets, the apex simple or with a slit or row of holes on the convex side, *Fissidentalium*, p. 63.

b^5. Small, thin, rapidly tapering, compressed between convex and concave sides; riblets very low and slight; see Section II, *Compressidens*, p. 123.

II. *No longitudinal sculpture.* (See also *Siphonodentalium*, p. 135).

a. Cavity of shell bicostate, *Lobantale*, p. xxxi.

a^1. Cavity of shell simple.

b. Apical slit a very long, straight, linear cleft; shell polished, curved, smooth or with spaced ring-like grooves, *Fustiaria*, p. 127.

b^1. Slit normal or wanting.

c. Sculptured with extremely oblique, crowded, encircling wrinkles, *Plagioglypta*, p. xxxi.

c^1. Smooth, or with normal growth lines only.

d. Conspicuously compressed laterally; apex with a broad slit on the convex side, *Bathoxiphus*, p. 121.

d^1. Subtriangular in section, the concave side wider; apex simple, *Gadilina*, p. xxxii.

d^2. Compressed between convex and concave sides; small, thin, rapidly tapering; no slit, notch or supplemental tube, *Compressidens*, p. 123.

d^3. Small, thin, fragile, smooth, very slender, but slightly tapering; acicular with simple or notched apex, or truncate with a supplemental apical tube, *Episiphon*, p. 117.

d^4. Without any of the foregoing combinations.

e. Quite arcuate, glassy, with numerous low variceal annular swellings, *Rhabdus*, p. 112.

e^1. Almost straight, glassy, smooth, thin, circular in section; no slit or notch, *Rhabdus*, p. 112.

e^2. Arcuate, smooth or with growth-striæ, section circular or oval, apex slit or simple, *Lævidentalium*, p. 97.

e^3. Smooth, but with longitudinal striæ in the young, lost with age in some specimens; see Section I, *Antalis*, p. 37; *Graptacme*, p. 85.

Of the subgenera defined above, the following are known only as fossils:—

Subgenus LOBANTALE Cossmann, 1889.

Lobantale COSSM., Catal. Illustr. Coq. Foss. Eoc. Paris, in Ann. Soc. Roy. Malac. Belg., xxiii, p. 7 (1889).

Shell slender, compressed, smooth except for growth-lines, the interior with two longitudinal ribs placed laterally, one on each side, giving a transverse section a bilobed shape. Type *D. duplex* Defr. (including the synonymous *D. bicarinatum* Desh.). Pl. 39, figs. 12,

Eocene, Paris Basin. No recent species known. A supplementary apical pipe is sometimes developed, as in species of the group of *D. filum*. In some Mesozoic and Palæozoic forms, not allied to the present group, there are also longitudinal ribs on the inside.

Subgenus PLAGIOGLYPTA Pilsbry.

Plagioglypta Pils., in Zittel's Text-book of Palæontology, Eastman's edit., p.

Shell circular or elliptical in section, without longitudinal sculpture, with close and fine obliquely encircling wrinkles throughout or on the posterior portion.

Type *D. undulatum* Münster.

Distribution, Carboniferous to Trias.

An apparently extinct group, differing from *Fustiaria* Stol. in the far closer oblique grooves with convex, rib-like intervals, and, so far as known, no apical cleft. It is especially characteristic of the early and middle Mesozoic. There are numerous species, such as *D. undulatum* Münst., *spitiense* Guembel, *tæniolatum* Sandb., *annulatum* Sandb., *dunkeri* P. & S., *tenue* Münst., etc.

Besides the foregoing subgenera, the following groups have been based upon fossil species, but they hardly seem to possess characters sufficient for subgeneric rank.

Subgenus GADILINA Foresti, 1895.

Bull. della Soc. Malac. Italiana, xix, p. 259.

Shell smooth and slender, imperfectly triangular in section, the concave side flattened, convex side rounded. Type *D. triquetrum* Brocchi. Lower Miocene (Elvesian) of Piedmont.

The recent *D. insolitum* E. A. Smith (see p. 109) probably falls into this group, though in it the subgeneric peculiarities are less accentuated than in the Piedmontese fossil.

Foresti thus defines the group, which he ranks as a subgenus of *Siphonodentalium:* Shell triangular in section throughout, not swollen in the middle; posteriorly tapering and curved; smooth; slightly contracted and distinctly oval toward the anterior aperture, simple and entire at the posterior orifice.

Section *Coccodentalium* Sacco, 1896.

Boll. Mus. Zool. ed Anat. Comp. R. Univ. Torino, xi, p. 98; Moll. Terr. Terz. Piem. e Ligur., xxii, p. 110.

Shell longitudinally costulate, the ribs strongly granose; apex as in the *D. novemcostatum* group of *Antalis.* Type *D. radula* Schröter.

This group, which we would hardly be disposed to individualize by a subgeneric name (see p. 29), comprises besides its type *D. radula* of the Piedmont Upper Miocene (Tortonian), a few recent species such as *D. carduus* Dall, its probable ancestor *D. callioglyptum* Pils. & Sharp of the San Domingo Oligocene, and *D. Tryoni* Pils. & Sh. of the same beds.

See also REIS, Geognost. Jahreshefte, 1896, p. 79, pl. 9, f. 5.

D. NANAIMOENSE (Meek), 1858.

D. nanaimoensis Meek, 1858. Trans. Albany Inst., Vol. iv, p. 44–45.

D. komooksense MEEK, 1876. Bull. U. S. Geol. Survey Terr., Vol. ii, No. 4, p. 364, pl. 3, f. 6. The description of both of these species is from the same specimen.

Cretaceous, Vancouver's Island.

D. NODULOSUM (Schlotheim), 1820.

Dentalites nodulosus SCHLOTHEIM, Die Petrifactenkunke, p. 94.

Cretaceous, Island of Moen, Denmark.

D. NORMANIANUM D'Orbigny, 1850. (New name for *D. nitens* Deslongchamps, 1842, not of Sowerby, 1814). Prodr. Paleont. Strat. Vol. ii, p. 46, No. 52.

D. nitens DELONGCHAMPS, 1842 (not of Sowerby, 1814). Mém. Soc. Linn. de Normandie, Vol. vii, p. 129.

Kimmeridge Clay, Villerville.

D. NUDUM Zekeli, 1852. Abhand. K. K. Geol. Reichs-Anstalt Wien, Vol. i, p. 118, pl. xxiv, figs. 11–12.

Senonian, "Gosaugebilde," Edelbachgraben, Gosau Valley.

D. OBSOLETUM Schlotheim, 1832. Syst. Verzeich. Petrifac. Samml., p. 67. *Nomen nudum.*

"Lohberg, bei Tonna."

D. OOLITHICUM Piette, 1856. Bull. Soc. Géol. France (2), Vol. xiii, p. 598, pl. xv, figs. 28, 29.

D. entaloides DESLONGCHAMPS, 1842 (not of Fleming, 1825). Mém. Soc. Linn. Normandie, Vol. vii, p. 128, pl. 7, figs. 36–38.

D. nitens TERQUEM ET JOURDY, Bath. de la Mos., p. 69. (Not of Sowerby).

Jurassic, Bathonian stage, Rumigny, Hedrequent, Domfront-en-Champagne, etc., France; Nemitz, Baltic region.

D. ORTHOCERAS Pilsbry & Sharp, 1898. New name for *Entalis? filosa* Koninck, 1883, not *D. filosum* Brod. & Sowb., 1830–'32.

Entalis? filosa Koninck, 1883. Ann. Mus. Roy. d'Hist. Nat. Belgique, viii, pt. 5, p. 219, pl. 49, f. 23, 24. (Not *D. filosum* Brod. & Sowb., 1830–1832, see p. 13).

Carboniferous, Visé, Belgium.

D. OVALE Malm. (Description not seen by us).

Jurassic, Dogger: Germany.

D. OVOSECTUM Sharp & Pilsbry. New name for *D. glabrum* Geinitz, 1839, not of Montagu, 1804.

D. glabrum GEINITZ, 1839, not of Montagu, 1803. Charac. d. Schichten and Petrefac. Sächisch.-böhm. Kreidegebirg. Heft i, p. 74, pl. 18, fig. 28; and Heft. ii, p. 11, pl. i, fig. 27.

Cenomanien, Tyssa, Limburg, Gorlitz, etc.

D. PARKINSONI Quenstedt, 1852. Handb. d. Petrefactenkunde, Tuebingen, p. 443, pl. 35, fig. 19. 2d edit., p. 531. Der Jura, pl. 65, f. 5, 6.

Middle Jurassic, Popielany, etc.

Dunker considers this identical with *D. entaloides* Desl.; see Palæontographica, xiii, p. 137.

D. PARVULUM (Stoliczka), 1868.

Fustiaria parvula STOLICZKA, Cretac. Faun. south. India, Vol. ii, p. 445, pl. xxvii, fig. 22.

Cretaceous, India.

D. PAUPERCULUM Meek & Hayden, 1860. Proceed. Acad. Nat. Sci. Phila., p. 178.

Cretaceous, Nebraska and S. Dakota.

D. PENTAGONALE Pilsbry & Sharp, 1898. New name for *D. quinquangulare* Guembel, 1861, not Forbes, 1844.

D. quinquangulare GUEMBEL, 1861. Geognos. Beschreib. Bayerisch. Alpengebirg., p. 409.

Trias of the Bavarian Alps.

May be an *Entalina.*

D. PLANICOSTATUM Hébert, 1855. Mém. Geol. Soc. France, 2 Ser., Vol. v, p. 374, pl. 29, fig. 11.

Cretaceous, Mendon, France.

D. POLYGONUM Reuss, 1844. Geogn. Skizz. aus Böhmen, Vol. ii, p. 201–202. We have not seen this work. The reference is taken from Reuss, Verstein. Böhm. Kreideform., 1845–6, Abth., I, p. 41, pl. xi, f. 5.

Cretaceous, Bohemia.

D. PUNCTATOSTRIATUM Guembel, 1861. (*Nomen nudum*), Geognos. Beschreib. bayerisch. Alpengebirg., p. 274.

Trias, Lodensee.

D. QUENSTEDTI Blake, 1875. Quart. Journ. Geol. Soc. London, Vol. xxxi, p. 226; figured in Quenstedt Der Jura, p. 98 (no name).

Kimmeridge Clay, England.

D. RHODANI Pictet & Roux, 1849. Mém. Soc. Phys., Nat. Hist., Geneva, Vol. xii, p. 150, pl. 27, fig. 13.

Cretaceous, Gualt, Mouths of the Rhone; Saxonet, France.

D. RHOTOMAGENSE D'Orbigny, 1850. Prodr. Paléont. Strat., Vol. ii, p. 156, no. 226.

D. rothomagense D'Orbigny, 1852. Misspelling for *D. rhotomagense* D'Orbigny, 1850. Prodr. Paléont. Strat., Vol. iii, index, p. 59.

Cretaceous, Rouen, France.

D. RIPLEYANUM Gabb, 1860. Journal Acad. Nat. Sci. Phila. (2 Ser.). Vol. iv, p. 393, pl. 69, fig. 48. See also, WHITFIELD, Paleont. N. J. Gastr. and Ceph., p. 167, pl. 69, f. 48.

Cretaceous, Ripley Group, Eufaula, Alabama.

D. RUGOSUM Mueller 1849 (not of Eichwald, 1846 nor of Dunker, 1848). Ueber die Gastrop. der Aachener Kreide, in Programm Koen. Gymnas. Aachen, p. 6, pl. iii, fig. 2; also reprinted in Monogr. Petrifac. Aachener Kreideform. which was published by the Ver. Preuss. Rhein. & Westphal. Bonn, p. 6, pl. iii, fig. 2.

Cretaceous, Lusberg.

This may prove to belong to the *Serpulidæ*, or possibly *Teredidæ*. The name is preoccupied.

D. RUGOSUM Spillman, 1860 (not of Dunker, 1848). Geol. Report of Mississippi, p. 389. *Nomen nudum.*

Cretaceous, Green Sand, Tombigbee.

D. SACHERI Alth, 1850. Geogn. Palæont. Beschreib. von Lemberg, in Haidinger's Naturw. Abhandl. (Wien) Vol. iii, pl. 226, pl. 12, fig. 2. Böhm, Die Kreidebildungen des Fürbergs u. Sulzbergs-bei Siegsdorf, Palæontographica, xxxviii, p. 70.

Cretaceous, Lemberg, Bavaria.

D. SATURNI Goldfuss, 1844. Petrifac. German., Vol. iii, p. 1, pl. 166, fig. 1.

Mont Eifel.

D. SIMILE Wissman, 1841. Beiträge Geognos. u. Petrefactenkunde s. ö. Tyrols. (Muenster), p. 91, pl. ix, fig. 8.

Lias.

D. SOLITICUM Piette, 1855. Bull. Soc. Geol. France (2), Vol. xii, p. 1122.

Jurassic, Rumigny, France.

D. SPITIENSE Guembel, 1866. Sitzungsber. K. bayer. Akad. Wissensch. München, Jahrg. 1865, Vol. ii, p. 360, plate, fig. 7.

Trias, Thibet.

D. STRAMINEUM Gabb, 1864. Geol. Surv. California, Paleont., i, p. 139, pl. 21, fig. 101.

Cretaceous: Northeast of Martinez, San Diego, etc., California.

D. SUBARCUATUM Conrad, 1853. Journal Acad. Nat. Sci. Phila. (2 Ser.), Vol. ii, p. 276, pl. 24, fig. 13.—WHITFIELD, Paleontology of New Jersey, Gastrop. and Ceph. Raritan Clays and Green Sand Marls, p. 166, pl. 20, f. 19–24.

Cretaceous: Lower Green Marls, Mullica Hill, and underlying clays at Crosswicks and Haddonfield, N. J.

D. SUBCYLINDRICUM Philippi, 1887. Tertiär. und Quartär. Verstein. Chiles, p. 105, pl. 12, f. 14.

Cretaceous, Algarroba and S. Vicente, Chili.

D. SUBPLANUM Pilsbry & Sharp, 1898, n. n.

D. cylindricum GARDNER, 1878. Quart. Jnl. Geol. Soc. London, 1878, Vol. 34, p. 61, pl. iii, figs. 21–25.

Cretaceous, Blackdown, England.

This is not *D. cylindricum* of Sowerby, according to Gardner, *l. c.* It may possibly be a *Ditrupa*, but in any case requires a new name.

D. SUBQUADRATUM Meek, 1860. Proceed. Acad. Nat. Sci. Phila. p. 311.

Jurassic, North Platte River.

D. TENUE Muenster, 1844. Goldfuss, Petrifac. German., Vol. iii, p. 2, pl. 166, fig. 6.

Jurassic, Pappenheim, Bavaria.

D. TENUICOSTATUM Böehm, 1891. Palæontographica, Vol. 38, p. 69, pl. ii, fig. 34a.

Cretaceous, Gerhardtsreiter Graben, Bavaria.

D. TORQUATUM (Schlotheim), 1820. GUEMBEL, Geol. von. Bayern. (3 Lief.), p. 669, 670, f. 19.

Dentalites torquatus SCHL., Die Petrefactenkunde, p. 94.

D. tonosum ZENKER, 1837, in Geinitz, Beitr. Kennt. Thueringer Musch. Gebr., pl. i, fig. 2.

Triassic Muschelkalk, Germany.

D. TURONIENSE Woods, 1896. Quart. Journ. Geol. Soc. Lond., Vol. 52, p. 96, pl. iv, figs. 16–17.

Cretaceous, Winchester, etc., England.

D. UNDULATUM Muenster, 1844, Goldfuss, Petrifac. Germ., vol. iii, p. 3, pl. 166, fig. 8.

Trias, St. Cassian, Tyrol.

D. VALANGIENSE Pictet & Campiche, 1864. Paléont. Suisse, (3), pt. 2, Foss. Terr. Cretac. Sainte Croix, p. 723, pl. 98, f. 16–18.

Valangian stage of the Neocomian, at Villers-le-Lac, near le Locle, Switzerland.

PALÆOZOIC SPECIES.

There may possibly be some accessions to the roll of Palæozoic scaphopods from the genus *Coleolus* of Hall, supposed to belong to the *Pteropoda*. The species are mainly thinner and straighter than the shells of Dentalium; but there are also thin and nearly straight Dentalia, as in the subgenus *Rhabdus*.

D. ACUMEN (Koninck), 1883.

Entalis acumen KON., Ann. Mus. Roy. d'Hist. Nat. Belgique, viii, pt. 4, p. 216, pl. 49, f. 22 (1883).

Carboniferous, Visé, Belgium.

D. ACUS Eichwald, 1856. Bull. Soc. Imp. Nat. Moscou, Vol. xxix, pt. 22, p. 584; Lethæa Rossica, i, p. 1062, Atlas, pl. 40, fig. 10.

Silurian, Orthoceratites limestone near Poulkovo, government of St. Petersburg, Russia.

D. ACUTISULCATUM Gurley, 1883. New Carb. Foss., p. 7. ("Publication not valid", see Miller, North American Geology and Palæontology, 1889, p. 402).

Carboniferous, U. S.

D. ANNULIFERUM Pilsbry & Sharp, 1898. New name for *D. annulatum* Sandb. not Gmel.

D. annulatum SANDBERGER, 1842. Neues Jahrb. Min., Geogn., Geol., etc., p. 399, (no description); Versteinerungen des Rheinischen Schichtensystems in Nassau, 1850–1856, p. 241, pl. 26, f. 20, 20a.

"Stringocephaluskalk," Villmar, Prussia.

D. ANNULOSTRIATUM Meek & Worthen, 1870. Proc. Acad. Nat. Sci. Philada., p. 45; Palæontology of Illinois (Geol. Surv. Ill., v), p. 589, pl. 29, f. 7.

Carboniferous, Danville, Illinois.

D. ANTIQUUM Goldfuss, 1844. Petrifac. German., Vol. iii, p. 2, pl. 166, fig. 2.

D. priscum "Muenster" in SANDBERGER, Jahrb. Min. Geol., 1842, p. 399.

Cf. WHITEAVES, Contrib. to Canadian Palæont. I, pt. iv, p. 311, pl. 45, f. 1, 2.

Devonian, at Mont Eifel, Visé, etc.

D. ARENARIUM Römer, 1855. Geol. Kennt. n.-w. Hartzebirges. Palæontographica, Vol. v, p. 13, pl. iii, fig. 16.

Spirifer-sandstone, Hartz Mountains.

May prove to be a Pteropod, *Coleolus.*

D. BARQUENSE Winchell, 1862. Proc. Acad. Nat. Sci. Phila., p. 425.

Subcarboniferous; Marshall Group, Michigan.

D. CANNA White, 1874. Rep. Invert. Foss., p. 23; Rep. U. S. Geograph. Surv. West of 100th Merid., Vol. iv, pt. 1, p. 156, pl. 12, f. 6 (1877).

Carboniferous, Utah and Arizona.

D. CORNU Koninck, 1877. Foss. Pal. Nouv.-Galles du Sud, pt. 3, p. 315, pl. 23, fig. 4.

Karu, N. S. Wales.

D. CYRTOCERATOIDES (Koninck), 1883.

Entalis cyrtoceratoides KONINCK, Ann. Mus. Roy. d'Hist. Nat. Belgique, viii, pt. 4, p. 216, pl. 49, f. 13–15.

Carboniferous, Visé, Belgium.

It is allied to *D. priscum.*

D. (?) DENTALOIDEUM (Phillips). (*Orthoceras dentaloideum* Phillips, 1836). Illustr. Geol. of Yorkshire, pt. ii, p. 239, pl. xxi, fig. 12.

Carboniferous, England.

A doubtful Dentalium. L.-G. De Koninck considers it equally likely to be a *Cyrtoceras.*

D. GRANDÆVUM Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 18.

Subcarboniferous, "Marshall Group," Burlington, Iowa.

D. GRANOSUM Eichwald, 1856. Bull. Soc. Imp. Nat. Moscou, Vol. xxix, pt. 2, p. 584; Lethæa Rossica, i, p. 1061, Atlas, pl. 40, fig. 7.

D. granosum var. *lævigatum* EICHWALD, 1860. Lethæa Rossica, Vol. i, pl. 40, fig. 11, no text.

Orthoceratites limestone, Poulkova, Russia.

D. HERCULEUM Koninck, 1863. Quart. Journ. Geol. Soc. London, Vol. xix, p 8, pl. iv, figs. 10–12.

Entalis herculea WAAGEN, Mem. Geol. Surv. India, Productus Limestone fossils, p. 181–182, pl. xvi, figs. 1, 2, 3 (1887).

Carboniferous "Productus Limestone," Salt Range, India.

D. IBERGENSE Rœmer, 1855. Geol. Kennt. n.-w. Hartzgebirges. Palæontographica, Vol. v, p. 36, pl. vii, fig. 7.

Upper Devonian, Iberg White Chalk, Hartz Mountains.

D. ILLINOIENSE Worthen, 1883. Geol. Surv. of Illinois, Vol. 7, p. 325.

Subcarboniferous; Lowest beds of the Chester limestone (Kaskaskia Group), Chester, Illinois.

D. INGENS Koninck, 1841. Descr. Anim. foss. terrain Carbonifère Belgique, p. 317, pl. 22, fig. 2. Ann. Mus. d'Hist. Nat. Belg., viii, pt. 4, p. 217, pl. 49, f. 10–12, 18, 19 (1883).

Carboniferous, Visé, Belgium.

A large species, shaped like *D. ceras*, but smooth with circular instead of longitudinal wrinkles. It attains a length of 200 mill.

D. inæquale RYCKHOLT, 1852, not of Bronn, 1831. Mém. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 67–68, pl. ii, figs. 41–42. (Carboniferous at Visé)=*D. ingens* de Kon., internal cast.

D. INORNATUM M'Coy, 1844. Synops. Carb. Foss. Ireland, p. 47, pl. 5, f. 30.—R. ETHERIDGE, Geol. Mag. (dec. ii), iv, p. 248, pl. 13. f. 1.

Carboniferous, Ireland; and "Ardross limestone," near Elie, Fife, Scotland.

D. MARTINI Whitfield, 1882. Ann. N. Y. Acad. Sci., Vol. ii, p. 203; Rep. Geol. Surv. Ohio, vii, p. 423, pl. 3, f. 10.

Devonian, Upper Helderberg limetone, near Dublin, Ohio.

D. MEEKIANUM Geinitz, 1866. Carb. und Dyas in Nebraska, 13, pl. 1, f. 20; Geol. Surv. Illinois, Vol. v, p. 590, pl. 29, f. 8.

Carboniferous, Danville, Illinois.

D. MISSOURIENSE Swallow, 1863. Trans. Acad. Sci. St. Louis, Vol. ii, p. 99.

Subcarboniferous, Kaskaskia Group, Chester, Illinois, and St. Mary's, Mo.

D. NAVICANUM Ryckholt, 1852. Mém. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 169, (no description), pl. x, f. 11.

Devonian, near Visé.

D. NOTABILE Eichwald, 1856. Bull. Soc. Imp. Nat. Moscou, Vol. xxix, pt. 2, p. 583; Lethæa Rossica, i, p. 1061, Atlas, pl. 40, fig. 9.

"Orthoceratites limestone" of Poulkova, Popovo and Poutilivo, Government of St. Petersburg, Russia.

D. ORNATUM Koninck, 1841. Descr. Anim. Foss. Carbonif. Belgique, p. 318, pl. 22, fig. 3; Ann. Mus. Roy. d'Hist. Nat. Belgique, viii, pt. 4, p. 218, pl. 49, f. 4–9, (1883).

Carboniferous, Visé, Belgium.

D. dentaloideum "Phillips" RYCKHOLT, Mélanges Paléont., pt. 1, p. 68, (not *Orthoceras dentaloideum* Phill.).

D.? PERARMATUM Ryckholt, 1852. Mém. Couronn. Acad. Roy. Sci. Belg., Vol. xxiv, p. 67, pl. ii, figs. 39–40.

Carboniferous, Visé.

With deKoninck, we doubt if this be a *Dentalium*. It bears spines toward the smaller end, being elsewhere smooth; circular in section.

D. PRIMARIUM Hall 1858. Rep. Geol. Surv. Iowa, i, pt. 2, p. 666, pl. 23, f. 16.

Subcarboniferous, Warsaw Group, Hancock Co., Illinois.

D. PRISCUM Münster, 1844. Goldfuss, Petrifac. German., Vol. iii, p. 2, pl. 166, fig. 3; Ann. Mus. Roy. d'Hist. Nat. Belg., viii, pt. 4, p. 215, pl. 49, f. 1–3, 20, 21.

Carboniferous, Tournay, Belgium.

Reported, but probably incorrectly, from Scotland.

D. RECTIUSCULUM Eichwald, 1846. Geogn. de Russie, p. 425; Lethæa Rossica, i, p. 1062, Atlas, pl. 40, fig. 12.

Upper Carboniferous, Goniatites beds of Kasalschy-datschy, Oural Mts., and near Serpoukhow, government of Moscow, Russia.

D. RUGOSUM Eichwald, 1846. Geogn. de Russie, p. 425; Lethæa Rossica, i, p. 1063, Atlas, pl. 40, fig. 8.

Upper Carboniferous: Sloboda, government of Toula, Russia.

D. SCOTICUM Young, MMS. in Kirby, 1880. Quart. Journ. Geol. Soc. Lond., Vol. xxxvi, p. 563 and 589. *Nomen nudum.*

Calciferous series of the Carboniferous, Great Britian.

D. SORBII King, 1850. Monogr. Permian Foss., p. 218.

D. sorbyi of some authors.

D. speyeri GEINITZ, 1852. Jahresber. der Wetterauer Gesellsch., 1850–'51. p. 198.

Permian: Ireland, Germany.

D. SUBCANALICULATUM Sandberger, 1842. Jahrb. Min. u. Geol., 1842, p. 399 (no description); Verstein. Rheinischen Schichtensystems Nassau, 1850–1856, p. 240, pl. 26, f. 19, 19a.

"Stringocephaluskalk," Villmar, Prussia.

D. SUBLÆVE Hall, 1877. New name for *D. obsoletum* Hall, 1858, in Miller, 1st edition Amer. Palæozoic Foss., p. 244.

D. obsoletum HALL, 1858. Rep. Geol. Surv. of Iowa, i, pt. 2, p. 724, pl. 29, f. 16, 17. (Not of Schlotheim, 1832).

Coal measures of Iowa.

D. TAENIOLATUM Sandberger, 1856. Verstein. Rhein. Schicht. Nassau, 1850–56, p. 241, pl. 26, figs. 21–21a.

Carboniferous, "Stringocephaluskalk," Nassau, Germany.

D. TENUISSIMUM Koninck, 1876. Palæont. Nouv.-Galles du Sud, pt. 2, p. 117, pl. 4, fig. 3.

Devonian, Yass, N. S. Wales, Australia.

D. VENUSTUM Meek & Worthen, 1861. Proc. Acad. Nat. Sci. Phila., p. 145.

Subcarboniferous, St. Louis limestone, Waterloo, Monroe Co., Illinois.

D. VERRUCOSUM Eichwald, 1856. Bull. Soc. Imp. Nat. Moscou, Vol. xxix, pt. 2, p. 584; Lethæa Rossica, i, p. 1063, Atlas, pl. 40, fig. 6.

Carboniferous: Artiuskian stage of the Permian, Artiusk, Oural Mts.

D. WALCIODORENSE (Koninck), 1883.

Entalis walciodorensis KONINCK, Ann. Mus. Roy. d'Hist. Belgique, viii, pt. 4, p. 215, pl. 49, f. 16, 17 (1883).

Carboniferous, Belgium.

Family SIPHONODENTALIIDÆ.

The earliest forms referable to this family appear in the middle Cretaceous, the number of species rapidly increasing to the present time, as shown in the following table:

	Cadulus	*Siphonodentalium*	*Entalina.*
Cretaceous	4	—	2
Eocene and Oligocene	26	3	—
Miocene and Pliocene	20	3	2
Recent	65	8	3

Genus ENTALINA Monterosato.

See p. 131. This genus first appears at the base of the Cenomanien, continuing to the present time.

E. CURVA (Gardner), 1878.

Siphonodentalium curvum GARDNER, 1878. Quart. Jnl. Geol. Soc. London, Vol. 34, p. 63, pl. iii, figs. 45–47.

Cretaceous, Gault at Folkestone, England.

This may be serpulid and allied to *Hamulus.*

E. GARDNERI Sharp & Pilsbry, 1898. New name for *S. affine* Gardner, 1878, not Sars, 1864.

Siphonodentalium affine GARDNER, Quart. Journ. Geol. Soc. London, Vol. 34, p. 62, 63, pl. iii, figs. 41–44.

Cretaceous, Gault at Folkestone, England.

E. TETRAGONA (Brocchi), 1814.

Dentalium tetragonum BROCC., Conch. Foss. Subapp., ii, p. 627, pl. 15, f. 26.—*Entalina tetragona* MONTEROSATO, and of SACCO, Moll. Terr. Terz. Piem. e Liguria, xxii, p. 114, pl. 10, f. 47–55, with var. *paucistriata* Sacc.

Dentalium karreri R Hörnes,

Miocene, Northern Italy and Vienna Basin.

Genus SIPHONODENTALIUM M. Sars.

S. DILATATUM (Cossmann), 1888.

Pulsellum dilatatum COSSM., Ann. Soc. Roy. Malac. Belg., xxiii, p. 11, pl. 1, f. 21.

Parisian Eocene, near Soissons.

S. HYALINUM Brugnone. Misc. Malac., pt. 2, p. 21, f. 32 (1876).

Pliocene, Ficarazzi, Italy.

Referred by Jeffreys to *Cadulus olivi,* but probably incorrectly. See p. 171.

S. MICROCERAS Bttg. MEYER, Bericht. Senck. Naturforsch Ges., 1882, 1883, p. 259 (no description).

Oligocene of Germany, Joachimsthal, Offenbach.

S. NEGLECTUM (Cossmann), 1888.

Pulsellum neglectum COSSM., Ann. Soc. Roy. Malac. Belg., xxiii, p. 11, pl. 1, f. 2, 3.

Parisian Eocene, Le Guepelle, Marines, Chaussy.

Genus CADULUS Philippi.

This genus first appears in the middle Cretaceous. The early forms are typical examples of the group *Gadila*, showing no features unlike the recent species of that section. The species are *gaultianus* Gardner, *obrutus* Conr. and *gabbi* Pils. & Sh.

In the Eocene there are numerous forms; and species of *Dischides* and *Polyschides* also make their advent; and in the Oligocene the number of species is further augmented, all of the modern types except the short, obese forms being represented, the latter appearing in the Miocene. Nearly all of the known Pliocene species are also recent, and hence are to be found in the text of this work rather than in the following list.

CADULUS ABRUPTUS Meyer & Aldrich, Journ. Cincinnati Soc. N. H., ix, 1887, p. 40, pl. 2, f. 2.

Oligocene, Newton and Wautubbee, Mississippi.

Considered by Dall and Aldrich a probable synonym of *C. subcoarcuatus* Gabb.

C. ANNULATUS Pilsbry, 1898. Proc. Acad. Nat. Sci. Phila.

Oligocene, Bowden, Jamaica.

C. BELLULUS Clark, 1895. Johns Hopkins Univ. Circular, xv, p. 5; Bull. U. S. Geol. Survey, No. 141, p. 72, pl. 14, f. 6.

Eocene, Woodstock beds, Matthias' Point, King George Co., Virginia.

C. (DISCHIDES) BILABIATUS (Desh.).

Dentalium bifissuratum DESH., Traité Elém. de Conchyl., Atlas, pl. 61, f. 11, 12, 14 (1864).

Gadus bilabiatus DH., Descr. An. s. V. Bassin Paris, ii, p. 219, pl. 3, f. 22–24.—*Siphonodentalium bilabiatum* COSSMANN, 1888.

Eocene, Paris Basin.

C. (DISCHIDES) BOURYI (Cossmann), 1888.

Siphonodentalium bouryi COSSMANN, Ann. Soc. Roy. Malac. Belg., Vol. xxiii, p. 13, pl. 1, figs. 6, 7.

Parisian Eocene, Parnes, Montainville.

C. (DISCHIDES) BREVIS (Deshayes).

Gadus brevis DH., Descr. An. s. Vert. Bassin Paris, ii, p. 219, pl. 3, f. 25–28.—*Siphonodentalium breve* COSSM., 1888.

Paris Basin, Eocene.

C. COLOBUS Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 474, pl. 11, f. 17–20.

Oligocene of San Domingo.

C. CORPULENTUS O. Meyer. Bull. No. 1, Geol. Survey of Ala., p. 66, pl. 3, f. 5 (1886).

Oligocene, Red Bluff, Mississippi.

C. CUCUMIS v. Koenen. A European Oligocene species of which we have seen no description.

C. DENTALINUS (Guppy). PILSBRY, in this Vol., p. 190, pl. 36, f. 21, 22.

Ditrupa dentalina GUPPY, Geol. Mag. n. ser., dec. ii, vol. I, 1874, p. 445.

Oligocene, Jamaica.

C. DEPRESSICOLLIS Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 473, pl. 11, f. 25–27.

Oligocene of San Domingo and Jamaica.

C. DEPRESSUS Meyer. Proc. Acad. Nat. Sci. Phila., 1884, p. 111, fig. in text.

C. compressus MEYER, Amer. Journ. Science (3), xxix, p. 463. (Nude name).

Eocene, Claiborne, Alabama.

C. DIPLOCONUS Seguenza, 1880. Form. Terz. Prov. Reggio (Calabria), p. 276.

Pliocene, Astian Stage, Italy.

C. ELEGANTISSIMUS Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci. Phila., 1897, p. 473, pl. 11, f. 28–30.

Oligocene of San Domingo.

C. FLORIDANUS Dall. Trans. Wagner Inst. Sci., iii, p. 446, pl. 23, f. 26 (with var. *burnsii* Dall).

Miocene, Chipola beds, Appalachicola River, Florida.

C. GABBI Sharp & Pilsbry, 1898. New name for *Dentalium pusillum* Gabb, not Philippi.

D. (Ditrupa?) pusillum GABB, 1864. Palæont. of California, i, p. 139, pl. 21, fig. 99. *Gadus pusillus* GABB, *olim.*

Cretaceous, northeast of Martinez, Alizos Creek, near Fort Tejon and Tuscan Springs, California.

C. GADULUS (Doderlein), 1862.

Gadus gadulus DOD., Giac. Terr. M. Pl. Ital. Centr., p. 16.—*Dentalium gadulus* Montg., ARDUINI, Conch. Pl. Bac. Albenga, p. 41, 1895.—*Gadila gadus* var. *gadula* SACCO, Moll. Terr. Terz. Piem., p. 118, pl. 10, f. 88, 89.

Tortonian Miocene, Montegibbio, Albenga, etc., northern Italy.

C. GAULTIANUS Gardner, 1878. Quart. Journ. Geol. Soc. London, xxxiv, p. 63, pl. 3, f. 48.

Gault, Folkestone, England.

C. JUVENIS O. Meyer. Bull. No. 1, Geol. Survey of Ala., p. 66, pl. 3, f. 4 (1886).

Oligocene, Jackson, Mississippi.

C. MEDIUS Deshayes, MMS., 1898. New name for *D. coarctatum* Costa not of Lamarck.

D. coarctatum COSTA, 1850, Faun. Reg. Napoli, p. 38, pl. 3, fig. 11, not of Lamarck, 1818.

We know nothing of the validity of this species except what may be gathered from Costa's work.

C. MEYERI (Cossmann), 1888.

Siphonodentalium meyeri COSSMANN, Ann. Soc. Roy. Mal. Belg., Vol. xxiii, p. 12, pl. i, figs. 4–5.

Parisian Eocene, Chaussy, Houdan.

C. MUCRONATUS Tate. Trans., Proc., Rep., Roy. Soc. South Australia, ix, 1887, p. 193, pl. 20, f. 10.

Muddy Creek Beds, South Australia.

C. (POLYSCHIDES) NEWTONENSIS Meyer & Aldrich. Journ. Cincinnati Soc. N. H., ix, p. 41, pl. 2, f. 3 (1886).

C. jacksonensis O. MEYER, Amer. Journ. Sci., xxix, 1885, p. 462; Geol. Surv. Ala., Bull. No. 1, p. 65, pl. 3, f. 8 a–b.

Oligocene of Newton and Jackson, Mississippi. Miocene of Chipola R., Fla. and Patuxent R., Md. (Dall).

C. NUTANS Böhm, 1891. Die Kreidebildungen des Fürbergs u. Sulzberg bei Siegsdorf in Oberbayern, in Palæontographica, xxxviii, p. 70, pl. 4, f. 26a.

Cretaceous, Höpfling, Bavaria.

C. OBLIQUATUS v. Koenen. A European Oligocene species, of which we have not seen a description.

C. OBRUTUS (Conrad), 1869.

Gadus obnutus CONRAD, Amer. Journ. Conch., v, p. 101, pl. 9, f. 18. See *t. c.* p. 227, errata. *Gadus obrutus.*

Gadus obrutus Conr., BOYLE, Bibl. N. A. Mesozoic Invert. Bull. 102, U. S. Geol. Surv., p. 131.

Cretaceous, Haddonfield, New Jersey.

C. OLIVI (Scacchi), 1835. See p. 170, pl. 31, f. 33–35.

Pliocene of Southern Italy and Sicily.

This species has repeatedly been reported as recent, but its actual occurrence living is doubtful. See text, p. 170.

C. PARIANUS Guppy, 1896. Proc. U. S. Nat. Mus., xix, p. 325, pl. 30, f. 7.

Oligocene, Trinidad.

C. (POLYSCHIDES) PARISIENSIS (Deshayes).

Dentalium denticulatum DESH., Traité Elément. de Conchyl., Atlas, pl. 61, f. 13, 15, 16 (1864).

Gadus parisiensis DH., Descr. An. s. Vert. Bassin Paris, ii, p. 218, pl. 3, f. 18–21.—*Siphonodentalium parisiense* COSSMANN.

Parisian Eocene.

C. PHENAX Pilsbry & Sharp, 1898. Proc. Acad. Nat. Sci., Phila., 1897, p. 472, pl. 11, f. 23, 24.

Oligocene of San Domingo.

C. (POLYSCHIDES) QUADRITURRITUS O. Meyer. Geol. Survey of Alabama, Bull. No. 1, p. 65, pl. 3, f. 7, 7a (1886).

Oligocene, Red Bluff, Mississippi.

C. SALICENSIS Seguenza, 1880. Form. Terz. Prov. Reggio (Calabria), p. 276.

Pliocene (Astian stage), Italy.

A variety of *C. ovulum?*

C. SIMROTHI Pilsbry, 1898. Proc. Acad. Nat. Sci. Phila.

Oligocene, Bowden, Jamaica.

C. SUBCOARCUATUS (Gabb), 1860.

Ditrupa subcoarcuata GABB, Journ. Acad. Nat. Sci., Phila. (2), iv, p. 386, pl. 67, f. 47 (1860).

Gadus subcoarctatus Gabb, of Conrad. *Cadulus subcoarctatus* of Dall, Aldrich et al.

Eocene: Wheelock, Texas.

The etymology of this name has been emended by various writers; but Gabb's intention is shown by his use of the name as here printed

in the explanation of plates as well as in the text of his paper, and upon his autograph label still preserved with the types in the collection of the Acad. Nat. Sciences of Philadelphia.

C. SUBFUSIFORMIS Jeffr., var. TAUROMINIMA (Sacco), 1897.

Loxoporus subfus. v. *taur.* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, p. 116, pl. 10 f. 78.

Lower Miocene of northern Italy.

C. TAUROTUMIDOSUS Sacco, 1897. Moll. Terr. Terz. Piem. e Ligur., xxii, p. 115, pl. 10, f. 68–73.

Lower Miocene, Sciolze northern Italy.

C. TAUROVULUS Sacco, 1897. Moll. Terr. Terz. Piem. e Ligur., xxii, p. 115, pl. 10, f. 64–67.

Lower Miocene, Monte dei Cappuccini, Italy.

C. TENUIS (Seguenza), 1880.

Helonyx tenuis SEG., Formazioni Terziarie nella Prov. di Reggio (Calabria), Real Accad. dei Lincei an. 1879–80, p. 118, pl. 11, f. 50.

Upper Miocene (Tortonian), Italy.

C. THALLUS (Conrad). DALL, Trans. Wagner Inst. Sci., iii, p. 445.

Dentalium thallus CONR., Journ. Acad. Nat. Sci., Phila., vii, p. 142, 1834.

Miocene: Maryland, Virginia, South Carolina and Florida.

C. TRANSSILVANICUS (Boettger), 1897.

Siphonodentalium transsilvanicum BOETTGER, Verh. u. Mittheil., Siebenb. Vereins für Naturwissensch. zu Hermannstadt, xlvi, p. 55.

Middle Miocene, Kostej, Banat, Hungary.

C. TUMIDOSUS Jeffr., var. PARVULINA Sacco, 1897. Moll. Terr. Terz. Piem. e Ligur., xxii, p. 116, pl. 10, f. 74–76. Also var. PERINFLATA Sacco, *l. c.*, pl. 10, f. 77.

Tortorian Miocene, S. Agata, northern Italy.

C. TURGIDUS O. Meyer, Bull. No. 1, Geol. Survey of Ala, p. 65, pl. 1, f. 10.—HARRIS, Bull. Amer. Paleont., i, No. 4, p. 187 (73), pl. 7, f. 2.

Midway stage of Eocene, Matthew's Landing, Alabama.

C. (POLYSCHIDES) TURRITUS (Lea), 1833.

Dentalium turritum LEA, Contributions to Geol., p. 35, pl. 1, fig. 3.

Eocene, Claiborne, Alabama.

C. VENTRICOSUS (Bronn), 1827.

Dentalium ventricosum BRONN, Verz. im Heidelb. Compt. befindl. Conchylien Jahrb., ii, p. 539.—*Gadila gadus* var. *ventricosa* and *gracilina* SACCO, Moll. Terr. Terz. Piem. e Liguria, xxii, p. 117, pl. 10, f. 80–85.—*Creseis gadus* BRONN, Lethæa Geogn., ii, p. 984, pl. 40, f. 3.—*Dentalium coarctatum* LAM., An. s. Vert., v, p. 346.—*Loxoporus ligusticus* RAZZORE, Alc. Scafop. Plioc. Ligur., p. 17, 1896.

Miocene of Northern Italy.

C. VICKSBURGENSIS O. Meyer. (Amer. Journ. Sci., xxix, 1885, p. 463), Geol. Survey, Alabama, Bull. No. 1, p. 65, pl. 3, f. 6 (1886).

Oligocene, Red Bluff, Vicksburg, Mississippi; Older Miocene, Florida.

APPENDIX II. SPECIES DESCRIBED AS SCAPHOPODA BUT BELONGING TO OTHER GROUPS.

The false-Dentalium species may conveniently be discussed under the following arrangement:

1. Molluscan, but non-Scaphopod species.

Non-molluscan { 2. Worm-tubes, *Serpulidæ* (p. 241).
3. Sundry other organisms (p. 247).

Most of the following species are here for the first time removed from the Scaphopoda; but a part of them, such as the common European *Ditrupa*, have long been known to be non-molluscan, and various rectifications of the position of sundry species may be found scattered through the literature. Locard (Ann. d'Agricult. Lyon, 1896, p. 253) has discussed the topic at some length.

1. Various other mollusca described as Scaphopods.

Dentalium aciculatum Hall, 1860. 13th Rep. N. Y. State Mus. Nat. Hist., p. 107.

Palæozoic; Marcellus Shale and Portage Groups.

=*Coleolus aciculatus*, referred by Hall to *Pteropoda*, but it may as likely be a *Scaphopod*.

Dentalium annulatum Mighels, Jay's Catalogue, edit. 4, p. 96, from Maine, may be a *Cœcum*. It is not *D. annulatum* Gmel.

Siphonodentalium breve R. B. Newton, Syst. List Edwards Coll. B. M., 1891, p. 287=*Euchilotheca elegans* Harris, Proc. Malac. Soc. Lond., i, p. 61. An Eocene Pteropod.

Dentalium corniculum Costa, Fauna Reg. Nap., Tubibranchi, Appendix, p. 55, pl. 4, f. 2. Belongs to *Cæcidæ*.

Dentalium cinctum Koninck, 1843. Descr. Anim. Foss. Terrain. Belgique, p. 318, pl. 23, fig. 3.=*Orthoceras subcentrale* Koninck, p. 514, pl. 44, fig. 3. *Carboniferous, Belgium.*

Coleolus crenatocinctus Hall, 1879. Pal. N. Y. v, pt. 2, p. 188, pl. 32, f. 1–3; pl. 32a, f. 3, 4. Considered a *Dentalium* by Whitfield.

Dentalium glabrum Montagu, 1803. Test. Brit., p. 497.=*Cæcum glabrum* (Montagu).

Dentalium imperforatum Montagu, Test. Brit., p. 496.=*Cæcum*.

Dentalium imperforatum Turton, Conch. Dict. Brit. Is., p. 39, 1819 (Walker Test. minuta rariora, etc., p. 4, pl. 1, f. 15).=*Cæcum*.

Dentalium intestiniforme Linn.=*Thylacodes polyphragma* Sassi (Mörch, P. Z. S., 1862, p. 66).

Dentalium jungii d'Orbigny; 1852. Prodr. Paleont. Strat., Vol. iii, index, p. 59.=*Fusus jungii*, a mistake in indexing.

Dentalium pygmæus Defrance, 1819. Dict. Sci. Nat., Vol. xiii, p. 71.=*Cæcum*.

Dentalium spinulosum Miller, MSS.=*Hamites spinulosus* Sowb., Min. Conch., iii, p. 29, pl. 246, f. 1 (1821).

Dentalium trachea Montagu, Test. Brit., p. 497, pl. 14, f. 10.=*Cæcum*.

2. *Vermes of the Family Serpulidæ.*

Genus Ditrupa Berkeley, 1834.

Zoological Journal, v, p. 426.

Worms of this genus form a calcareous shell shaped like a *Dentalium* or a narrow *Cadulus* (such as *C. acus* or *panamensis*), generally constricted anteriorly or with swollen rings or constrictions at irregular intervals along the tube, which is very earthy and brittle.

Various species have been described as *Dentalium*, such as *D. strangulatum* Desh., *D. subulatum* Dh. (pl. 37, fig. 16), *D. arietinum* Müller (pl. 37, fig. 19), and *D. goreensis* Clessin (pl. 37, fig. 17). Forms a good deal like *D. subulatum* occur in the West Indies, and there is a multi-annulate East Indian species. They probably occur in most seas. The irregularity and earthy texture of the tube are generally sufficiently conspicuous to prevent any confusion with Scaphopod shells. Some related genera of *Serpulidæ* have more or less similar shells; but the generic and specific characters of these

organisms are to be found in the opercula, gills, etc., rather than in the tubes, which give characters of but little value to the modern helminthologist.

In early Tertiary and Cretaceous deposits there are several species with solid, thick, heavily ribbed shells, such as *Serpula heptagona* Sowb., "*D.*" *rudis* Gabb, etc. Their exact generic relations are not known to me, but they are obviously members of the family *Serpulidæ*, (see pl. 37, fig. 20, "*D.*" *abbreviatum* Dh.).

The species are arranged alphabetically without regard to geological horizon, and no attempt at synonymy, even when obvious, has been made.

Dentalium abbreviatum Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, Vol. ii, p. 352, pl. xviii, figs. 21–22; see also Descr. Anim. s. Vert. Bassin Paris, Vol. ii, 1864, p. 199, pl. 3, figs. 5–7; Eocene of the Paris Basin(="*Serpula*" *heptagona* Sow.).

Dentalium arietinum Müller, Zool. Danicæ Prodromus, p. 236, 1776.

Dentalium bulbosum Bronn, 1831. Ital. Tert. Gebild., p. 85 ("=*D. entalis* Brocchi in part"). See also Eichwald, Lethæa Rossica, iii, p. 136.—Stefani & Pantanelli, Bull. Soc. Mal. Ital., iv, p. 67.—"*Unbekannte Versteinerungen*" Hoernes, Foss. Moll. Tert. Beckens Wien, in Abhandlungen der Kaiserlich-königlichen Geologischen Reichsanstalt, 1856, p. 664, pl. 50, f. 41. Pliocene, Italy, Russia, etc.

Dentalites cingulatus Schlotheim, Die Petrefactenkunde, p. 94.

Dentalium carinatum O. G. Costa, Faun. Reg. Nap., Tubibranchi, pp. 24, 52 (1851).

Dentalium coarctatum Brocchi, 1814. Conch. Foss. Subapp., ii, p. 264, pl. i, fig. 4. A Calabrian Pliocene *Ditrupa!*

Dentalium corneum Linn., Syst. Nat. (12), p. 1263 (=*Ditrupa arietina*).

Dentalium cylindraceum Costa, 1850. Faun. Reg. Napoli, Dent., p. 39, pl. 3, fig. 10=*Ditrupa*. Italian Pliocene? near Caramanico.

Dentalium cylindricum Sowerby, 1814. Mineral Conchology, Vol. i, p. 179, pl. 79, fig. 2. Emsworth, England. According to Gardner, this *Ditrupa* is a synonym of *Dentalium planum* Sowerby, described on the same page.

Dentalium deshayesianum Galeotti, 1837. Mém. Couron. Acad. Roy. Bruxelles, Vol. xii, p. 62, pl. 4, f. 7. Plateau D'Assche of Brabant.

Dentalium deforme Lamarck. Anim. s. Vert., v, p. 344, 1818.

Dentalium difforme J. de C. Sowerby, in Dixon, 1850. Geology of Sussex, p. 348, pl. xxix, fig. 10.

Dentalium falcatum Conrad, 1869. Amer. Journ. Conch., v, 1869–'70, p. 44, pl. 1, figs. 12–16. See under *Hamulus*.

Dentalium goreeanum Clessin, Conchyl. Cab., p. 42, pl. 10, f. 9, 10.

Dentalium hamatum Forbes, 1846. Trans. Geol. Soc. Lond. (2). Vol. vii, p. 138, pl. xv, fig. 8. Cretaceous of India. An imperfect cast of a longitudinally ribbed worm tube.

Dentalium incrassatum Sowerby, 1814. Mineral Conchology, i, p. 180, pl. 79, fig. 3, 4.

Dentalium incurvum Renier, 1804. Tavola Alfabet. Conch. Adriat. Not seen by us.

Dentalium indistinctum Fleming. Edinburgh Phil. Journ., xii, p. 241, pl. ix, fig. 2 (1825). Carboniferous, England.

Dentalium minutu Linn., Syst. Nat. (10), p. 786 = *D. minutum* L., Syst. Nat. (12), p. 1264, and of Gmelin, p. 3737, is not identifiable, but Hanley surmises that it may be *Cadulus gadus*.

Dentalium nigrofasciatum Eichwald. Naturhist. Skizze Lithuanen, Volhyn., etc., p. 199.—*Dentalium incrassatum* Sow. Eichwald, Lethæa Rossica, iii, p. 136, pl. 3, f. 20 a, b. Pliocene, Zukowce, Volhynia, Russia.

Dentalium nigrum Lam., 1818. An. s. Vert., p. 345; see also Chenu, Illustr. Conchyl., i, pl. 3, f. 9. Tube of *Ditrupa* or some allied genus of worms.

Dentalium pellucidum Gmel., Syst. Nat. (13), p. 3738 (Schroeter, Einleitung in Conch. 2, p. 529, pl. 6, f. 17).

Dentalium pusillum Philippi, 1836. Enum. Moll. Siciliæ, Vol. i, p. 245 (Palermo), has been referred to *Dischides politus*, but it may be a *Ditrupa*.

Dentalium planum Sowerby, 1814. Mineral Conchology, i, p. 179, pl. 79, fig. 1.

Dentalium radicula Lamarck, 1818. Anim. s. Vert., Vol. v, p. 345.

? Dentalium rudis Gabb, Trans. Amer. Philos. Soc. (n. ser.), xv, p. 244 (1873). See also Pilsbry & Sharp, Proc. A. N. S. Phila., 1897, p. 474, pl. 10, f. 4, 8. Oligocene, San Domingo.

Dentalium septangulare Fleming, Edinb. Philos. Journ., xii, 1825, p. 240. Probably = the following.

Dentalium septemcostatum Abich in Trautschold, 1859. Bull. Soc. Nat. Moscou, xxxii, pt. i, p. 314, pl. 6, fig. 5. Eocene and Oligocene, Armenia. Probably = "*Serpula*" *heptagona* Sowerby, with which Trautschold, Bull. Soc. Nat. Mosc., 1868, pt. 1, p. 168, identifies it.

D. serratum Pictet et Roux, 1849. Mém. Soc. Hist. Nat. de Genève, 1849, Vol. 12, p. 150, pl. 27, f. 12 a–b. Cretaceous, Mouths of the Rhone, France. Probably belongs to *Hamulus*.

Dentalium sexcarinatum Goldfuss, 1844. Petrifac. German., Vol. iii, p. 4, pl. 166, fig. 12.

Dentalium sexradiatum Goldfuss. "Craie super. Maestricht." We have seen no work in which this species is described. It may be an error for *sexcarinatum*.

Dentalium sowerbyi Michelotti, 1847. Terr. Mioc. de Ital. Septentr., p. 145, 1847.

Dentalium strangulatum Deshayes, Mém. Soc. d'Hist. Nat. de Paris, ii, p. 382, pl. 16, f. 28 (1825).

Dentalium strangulosum "Deshayes," Gümbel, 1861 (misspelling for *D. strangulatum* Deshayes). Gümbel, Geognos. Beschreib. Bauerisch. Alpengebirg., p. 604.

Dentalium subcarinatum MUNSTER in Goldfuss. Quoted by Ryckholt, Mem. Couron. Belg., 1850–51, Vol. xxiv. This may be a misspelling for *D. sexcarinatum* Münster in Goldfuss, 1844.

Dentalium subulatum Desh., Mém. Soc. d'Hist. Nat. Paris, ii, p. 373, pl. 16, f. 29 (1825).

Dentalium undatum Defrance, 1819. Dict. Sci. Nat., Vol. xiii, p. 72. Near Angers (=*Ditrupa*).

Genus HAMULUS Morton, 1834.

Hamulus MORT., Synopsis Organic Remains of the Cretaceous Group of the U. S., p. 73, type *H. onyx* Mort.—*Falcula* CONRAD, Amer. Journ. Conch., vi, July, 1870, p. 77, type *D. hamatus* Con., 1870, error for *D. falcatum* Con., 1869.

Shell tubular as in *Dentalium*, but very much and progressively more curved toward the smaller end; exterior coarsely and rudely ribbed longitudinally; aperture contracted, circular, smaller orifice simple, without an accessory tube. Type *H. onyx* Mort.

Cretaceous of the United States, Europe and India.

This genus is like *Pyrgopolon* in the contracted aperture and rude, irregular growth, but it is more curved and apparently with-

out an inserted apical tube. We do not hesitate to refer it to the *Serpulidæ*. See pl. 37, fig. 12, *H. onyx* Mort., Alabama.

The genus *Falcula* of Conrad was based upon internal casts of *Hamulus*. Type *F. falcata* Conr., pl. 37, figs. 10, 11, from the Lower Green Marls at Crosswicks, N. J.

Hamulus onyx MORTON, *l. c.*, pl. 2, f. 8 (Lynch's Creek, S. C.); pl. 16, f. 5 (Erie, Ala.), is the type of the genus.

Hamulus squamosus GABB, Journ. A. N. S. P. (2), iv, p. 398, pl. 68, f. 45.

Hamulus major GABB, t. c., p. 399, pl. 68, f. 46, Ripley Group, Eufaula, Alabama.

Hamulus falcatus CONRAD, Amer. Journ. Conch., v, p. 44, pl. 1, f. 12, 16 (as *Dentalium falcatum*), including *D.? hamatus* Conr., Amer. Journ. Conch., vi, p. 77, from the New Jersey Cretaceous, described from internal casts, by which it is still solely known.

It scarcely falls within the province of this work to enumerate the European and Indian species of similar forms, except when described as *Dentalium*.

Dentalium octocostatum FRASS, 1867. Jahresh. Nat. Kund. Wuerttemberg, Vol. 23, p. 239, pl. iv, fig. 13.

Cretaceous at Marsâba, Palestine.

Genus PYRGOPOLON Montfort, 1810.

Pyrgopolon MONTF., Conch. Syst., i, p. 394 (1810), type *P. mosæ* Montf.—*Entalium* DEFRANCE, Dict. Sci. Nat., xiv, p. 517 (1819), type *E. rugosum* Defr.—"*Entale* Defrance" BLAINV., Man. de Malac., p. 628 (1825), type *D. duplicatum*.—"*Entalis* Defr.," SOWERBY, A Conchol. Man., p. 42 (1839), type *D. duplicatum* Blainv.—*Pharetrium* KOENIG, Icones Fossilium Seciles, p. 4 (1825).

Shell club-shaped, straight, or curved toward the apex, the outside bevelled (as though constricted, but the lumen does not contract) at the oral aperture; dull, chalky, with irregular encircling undulations; the inner layer generally projecting as a tube at the apex.

Type *P. mosæ* Montf., pl. 37, fig. 13; see also *P. clava* Lam., pl. 37, figs. 14, 15.

Upper Cretaceous, especially at Maestricht in the Netherlands.

Blainville, as was his custom, used Defrance's French vernacular name "Entale" instead of his Latin form, and for some occult reason he changes the name of the species. Sowerby's variation was

obviously due to a desire for pure Latinity, his information being from Blainville. Subsequent developments ensued, further complicating the question. Gray (P. Z. S., 1847, p. 159) evidently thought that the apical tube was due to repair of injuries, and he establishes a genus *Entalis* with *Dentalium entalis* as type. This of course is totally different from Sowerby's "*Entalis*," which was a Latinization of "Entale," and based ultimately upon the type of *Entalium* Defrance.

In short, *Entalium* Defrance, *Entale* Blainville and *Entalis* Sowerby pertain to *Pyrgopolon*, a worm; *Entalis* Gray and later authors is a form of *Dentalium*. See also page 37 of this volume.

The irregular growth and two-layered structure of these shells is conclusive evidence that they belong to the Serpulid worms. A number of species have been described under various generic names—*P. mosœ* Montf., *Dentalium clava* Lam., *D. crassum* Desh., *Pharetrium fragile* König—but they are probably variations of one or two Protean species. *D. tricostatum* Goldf. is apparently a *Pyrgopolon*.

Dentalium browni Hisinger, 1837. Lethæa Suecica seu Petrifak. Sueiciæ, p. 21, pl. iv, fig. 9 (not seen by us).

Dentalium clava Lamarck, 1818. Anim. s. Vert., v, p. 346.

Dentalium crassum Deshayes, 1825. Mém. Soc. Hist. Nat. Paris, ii, p. 373, pl. 18, fig. 20.

D. duplicatum Blainville, Man. de Mal., p. 628 (1825); a nude name.

Pyrgopolon mosœ Montfort, 1810. Conch. Syst., i, p. 394–396.

Dentalium tricostatum Goldfuss, 1844. Petrifac. German., iii, p. 3, pl. 166, fig. 11. Cretaceous, Westphalia.

Dentalium wilsoni Frass, 1867. Jahresh. Nat. Kund. Württemberg, Jahrg. xxiii, p. 239, pl. iv, fig. 12.

Cretaceous, Marsaba, Palestine.

Spirodentalium Walcott, 1890.

Spirodentalium Walcott, Proc. U. S. Nat. Mus., xiii, p. 271.

"Shell tubular, curved, opened at both (?) ends, attenuated posteriorly; aperture circular, surface spirally striated."

Type *S. osceola* Walcott, (*l. c.*, pl. 20, f. 12) from the upper portion of Cambrian (Potsdam terrane), Osceola Mills, Wisconsin. Pl. 37, fig. 18.

Described from one specimen occurring "in a friable, brown sandstone as cast and the matrix." "Longitudinally marked by

several narrow grooves." "Surface ornamented by spiral striæ that, from the portion of the surface preserved, passed around the tube three or four times in a length of 6 centimeters, the tube having a diameter of 7 mill. at aperture and 2·5 mill. at the posterior end."

The character of the sculpture—longitudinal grooves and spiral striæ—is radically unlike any form known to belong to the *Scaphopoda*, and the genus can scarcely be admitted to be molluscan without more evidence than the wretchedly preserved specimen yet known affords. It may belong to the *Vermes*, or to the ancient group of so-called *Pteropoda*.

3. Sundry other non-molluscan organisms.

Dentalium clausum TURTON, Conch. Dict. Brit. Is., p. 39 (1819). Quill of a sea-bird's wing feather, teste Forbes & Hanley, and Jeffreys.

Dentalium cornicula d'ORBIGNY, 1852. Prodr. Paleont. Strat., Vol. iii, index, p. 59, = *Dentalina cornicula* (Foraminifera). A mistake in indexing.

APPENDIX III.

Additional data upon Recent and Fossil Scaphopoda.

(*Recent species*).

D. ELEPHANTINUM L. (p. 1).

Reported from the Red Sea by Issel, Mal. Mar Rosso, p. 235.

D. BISEXANGULATUM Sowb., (p. 15).

Reported from the Querimba Islands and Mozambique (Peters coll.) by von Martens, Monatsber. Preuss. Akad. Wiss. Berlin, 1879, p. 739.

D. OCTANGULATUM Donovan (p. 16).

Under the name *D. octogonum*, von Martens (Vorderasiatische Conchylien, p. 102) records this from Bender-Abbas, Persian Gulf (G. Doria!). See also Issel, Mal. Mar Rosso, p. 302.

D. TEXASIANUM Philippi. Pl. 37, figs. 1-9.

See pp. 20–22, as *D. gouldii*. Two specimens are illustrated on plate 37, collected at Sanibel Island, west coast of Florida, by Chas. W. Johnson. They show considerable variation, but correspond

well with Philippi's description of *D. texasianum*. We are, therefore, disposed to rank *D. gouldii* as a form of *texasianum*, which has many years of priority of description. To the references should be added *D. texasianum* Ph., Roemer, Texas, p. 454 (1849).

Possibly the "*D. pseudosexagonum* Dh." reported from Tucacas, Venezuela, by Higgins & Marratt, Moll. Voy. 'Argo,' Proc. Lit. and Philos. Soc. Liverpool, xxxi, 1877, p. 416, is this species. There are many errors in the 'Argo' identifications.

D. bednalli Pilsbry & Sharp, n. sp. Pl. 39, figs. 1, 2, 3.

Shell soiled or Isabella-whitish, moderately arcuate, the curvature mainly posterior. Sculpture: at and near the apex with 7 strong, rounded ribs separated by deeply concave and decidedly wider intervals; passing anteriorly the ribs become lower and wider, and tend to split by the appearance of progressively deepening sulci on their side slopes, so that at the aperture there are about 10 very low ribs of unequal prominence, besides some incipient ones; the intervals shallow and narrower than the ribs. Growth striæ fine and rather inconspicuous throughout, no longitudinal striation. Aperture subcircular, retaining a slightly hexagonal form, as long as wide; apex rather large, the orifice small, oval, longer than wide, with thick walls; no slit or notch. Length 19, diam. at aperture 2·8, at apex 1·3 mill.

St. Vincent's Gulf, South Australia (W. T. Bednall).

? *D. octogonum* of Adcock's Hand List of the Aquatic Mollusca inhabiting S. Australia, p. 10 (1893).

The fundamental form may prove to be six-ribbed rather than seven-ribbed. The two costate species of this region, *D. tasmaniense* and *D. weldianum*, are not known to me by specimens, and neither of them have been figured, but from the brief descriptions published (see p. 9) this species seems distinct from either of them.

D. conspicuum Melvill. Pl. 33, fig. 60.

Shell shining, subulate, arcuate, milk-white, longitudinally delicately striated, the striæ unequal, here thin and there thicker, spirally irregularly concentrically encircled by liræ; at the apex octagonal, toward base vanishing, the base itself very smooth, rotund. Length $1\frac{3}{4}$, diam. $\frac{3}{16}$ inch (*Melv.*).

Karachi.

D. conspicuum Melv., Mem. and Proc. Manchester Lit. and Philos. Soc., xli, pt. 3, 1896–97, p. 21, pl. 7, f. 28 (1897).

A milk-white, conspicuous species, slightly arcuate, eight-angled at the apex, the longitudinal striæ very unequal down the body of the shell, and entirely vanishing before the base, which is very smooth and round at the orifice. It is concentrically unequally lirate; two specimens (*Melv.*).

D. concinnum von Martens.

Shell weakly curved, with distinctly defined but not sharp longitudinal ribs, at the apical end 12 in number, increasing anteriorly by intercalation to more than double that number, separated from each other by about double the breadth of the ribs; becoming weaker anteriorly, and with fine, crowded circular lines equally developed upon ribs and interstices; white, somewhat shining. Apex without slit, thick-margined, with 12 small notches outside. Aperture somewhat elliptical and oblique to the axis. Length of chord 44, of arc 46 mill.; longer diameter of aperture 4, shorter 3½ mill.; diameter of the apex 1 mill. (*Martens*).

West Coast of Africa, N. lat. 10′ 6′ 9″, W. lon. 17° 16′ in 150 fms. (Gazelle Exped.).

D. concinnum Martens, Sitzungs-Bericht Ges. Naturforschender Freunde zu Berlin, meeting of June 18, 1878, p. 134.

Evidently a member of the group of *D. agassizi* (p. 26), and to be placed near *D. shoplandi.*

D. quadrapicale Sowerby (p. 34).

Reported by Mr. E. A. Smith from off the coast of Travancore, South India, in 406 fms., dredged by the ‘ Investigator ’ (Ann. Mag. N. H., xviii, p. 371, November, 1897). The specimens are somewhat larger than that figured by Sowerby, the largest having a length of 40 mill.

A section of *Dentalium*, Tesseracme, may advantageously be erected for the forms included in the “ group of *D. quadrapicale,*” p. 31.

D. pretiosum ‘ Nutt.,’ Sowerby (p. 44).

Carpenter says somewhat enigmatically that the *D. pretiosum* of the Mazatlan Catalogue is probably *D. lacteum* Phil. We know of no such species. See Rep. Brit. Asso. Adv. Sci., 1863, pp. 545, 666, and Moll. Western N. A., pp. 31, 152.

There is also a museum name afloat "*Antalis denseliratum* Cpr." for young *indianorum* with a distinct slit on the convex side. One such in U. S. Nat. Mus. from San Pedro (No. 19,463), is 19 mill. long, 2·9 wide at aperture.

D. AGILE Sars (p. 46).

Off C. Spartel, Marocco, Sahara and Azores, 337–650 fms., 'Talisman' Exp. (Jeffreys, P. Z. S., 1884, p. 147).

D. ENTALIS L. (p. 42).

Mr. J. T. Marshall records new British localities for the varieties *anulata* and *infundibulum* in Journ. of Conch., ix, p. 61. The former "lives in fine sand in deep water, while the var. *infundibulum* occurs on rough ground; the latter is really a stunted form, caused by the action of a rough bottom wearing away and successively breaking off the point."

D. OCCIDENTALE Stimp. (p. 47).

Verrill (Proc. U. S. Nat. Mus., iii, p. 394) called attention in 1880 to the singular error of Jeffreys, Sars and others in regard to this species, which I have noticed at the foot of p. 47. He gives the range as all along the coast of New England and Nova Scotia, abundant on muddy bottoms in 50 to 300 fathoms. Jeffreys adds the locality Bay of Biscay, 1,062 fms., 'Travailleur' Exp. (Jeffreys, P. Z. S., 1884, p. 147, as "*D. striolatum*").

D. DENTALIS Linné (p. 53).

Var. *crocea* Monts., of a beautiful saffron yellow, with the apex rose tinted, and var. *rosea* Monts., entirely rose colored, are reported from the Gulf of Gabes by Ph. Dautzenberg, Journ. de Conchyl., 1883, p. 302.

D. PANORMUM Chenu (p. 54).

Second paragraph of references should read *D. pseudo-entalis* O. G. Costa; not "*pseudo-antalis.*"

Jeffreys (P. Z. S., 1884, p. 147) records it from Cape St. Vincent and off Senegal, in 32½ to 1,723 fms. (Talisman Exped.).

D. DISPARILE Orb. (p. 56).

D. eburneum Turton, Conchol. Dict. Brit. Is., p. 37 (1819) = *D. album* Turton, t. c., p. 256, is evidently either *D. disparile* or *variabile*, but which is uncertain. The doubt causes us to reject the name *album*, which is prior to those of both species mentioned.

D. MULTISTRIATUM Deshayes. Pl. 39, fig. 5.

Small, narrow, generally but little curved, white, yellowish or grayish; entirely covered with fine, crowded striæ, continuous from base to apex. In some individuals these striæ are a little wider, less crowded, with a fine thread interposed; but in the majority of shells they are equal, rounded, sometimes quite regularly spotted with gray or translucent white on an opaque white ground. Apex ordinarily worn, the striæ often deeper than at the base; aperture perceptibly oblique, with very sharp peristome. Length 20, greatest diam. 3 mill. (*Desh.*).

Found with *D. variabilis*, and presumably from India. (Desh.).

D. multistriatum DESHAYES, Mém. Soc. Hist. Nat. Paris, ii, p. 358, pl. 18, fig. 11.

Apparently resembles some forms of *D. antillarum*. It is known to us only from the above description and figure.

D. CANDIDUM Jeffreys (p. 72).

Off Marocco, Sahara and Canaries, 629–1,429 fms., 'Talisman' Exp. (Jeffreys, P. Z. S., 1884, p. 147).

D. CAPILLOSUM Jeffreys (p. 77).

Off west coast of Africa and Azores, 681 to 2,711 fms., 'Talisman' Exp. (Jeffreys, P. Z. S., 1884, p. 147).

D. MAGNIFICUM E. A. Smith, (p. 78).

Shell large, thick, moderately curved, perceptibly tapering posteriorly, obliquely truncated anteriorly; sculptured everywhere with many delicate ribs crenulated by transverse striæ; slit narrow, of varying length. Length 115, greatest diam. 15 mill. (*Smith*).

Lat. 8° 40′ N., long. 81° 27′ 35″ E., in 637–800 fms.; *off Trincomalee, east coast of Ceylon.*

Dentalium magnificum SMITH, Ann. Mag. N. H. (6), xviii, p. 371, Nov., 1896.—PILSBRY, this vol., p. 78.

The description of this species was overlooked by me when the MS. for part 65 of this volume was in preparation. Mr. Smith writes:

"This fine species is as large as the Japanese *D. vernedei* or the fossil *D. grande* Desh. The form, however, is more rapidly tapering than that of either, and the sculpture is not precisely similar; the aperture is larger than in either of the species quoted and almost

circular. The longitudinal ridges are fine and numerous, numbering about twenty-five to thirty at an inch from the apex. Towards the anterior end intervening riblets appear, so that the interstices, which above are broader than the liræ, become narrower. The lines of growth are distinct, and on crossing the riblets towards the posterior end produce a granulated appearance; the ridges are much smoother anteriorly and less elevated. The length of the fissure is variable, but this is probably chiefly due to damage. In the most perfect specimen it is 13 millimetres in length and rather more than half a millimetre in width. All three specimens exhibit reparation of injuries at the anterior end, and in two the posterior extremity has been broken off; these injuries are probably done by fishes or crustaceans. The shells are whitish, but coated with a dark brown earthy deposit. The Rev. Professor H. M. Gwatkin informs me that the radula is quite normal, and that the figure given by Sars of *Antalis striolata* closely represents it, except that in the present species 'the central tooth is a little wider and the inner edge of the lateral makes a smoother muzzle.'"

D. EXUBERANS Loc. (p. 79).

By oversight, the date "1847" instead of 1897, appears in the reference line below this species and *D. scamnatum*, on the same page.

D. RECTUM Gmel. (p. 81).

The locality "India" is incorrect, the species being an Italian Pliocene fossil which also occurs living in deep water in the eastern Atlantic, according to Fischer. *D. delessertianum* is a synonym. See p. 213.

D. SEMIPOLITUM B. & S. (p. 91).

Additional localities are: San Pedro, California; Margarita Bay on the Pacific coast of Lower California. A specimen from Boca de los Pedras, in the Gulf of California, measures: length 34, diam. 3·2 mill., and is lemon-tinted toward the apex (No. 46,203 U. S. Nat. Mus.). Another from San Ignacio Lagoon, on the ocean coast of the Peninsula, measures length 34, diam. 2·7 mill.

D. EBURNEUM Linn. (p. 115).

Reported under the name "*politum* Lam.," from the Gulf of Suez at 10 meters depth by Issel, Mal. Mar Rosso, p. 236. We do not vouch for the correct identification of the specimens.

D. FILUM Sowerby (p. 118).

To the synonymy of this species should be added: *D. funiculus* Brugnone, 1877 (see p. 204) of the Italian Pliocene, and *D. lœve* Hilgard & Hopkins, 1878 (p. 217) from the Pleistocene of Louisiana.

Jeffreys (P. Z. S., 1884, p. 147) adds the locality: *off Sahara*, 1,261 fms. (Talisman Exp.).

D. STEARNSII Pilsbry & Sharp.

New name for *D. simplex* P. &. S., 1897, not *D. simplex* Michelotti, 1861; see p. 125. This little species now has the honor of bearing the name of a life-long student of West American mollusks.

D. hyalinum "Leach MS. in Brit. Mus.," Sowerby in Conch. Icon., pl. 7, f. 49 (*Antalis hyalina* Clessin) is a smooth species with the apex and slit much as in *D. splendidum;* locality unknown. As the name is preoccupied by Philippi, and the specific value of the form is doubtful, it had better be dropped.

"*D. erectum* Verkrz., Jam." of Paetel's Catalogue, i, p. 593, is unknown to us. There is an *erectum* of Sowerby, but it is from Australia, not Jamaica.

"*D. zonatum* Orb., Jam." Paetel's Catalogue, i, p. 594 is unknown to us.

DENTALIUM MODICELLUM Kurtz.

Catalogue of Recent Marine Shells found on the coasts of North and South Carolina p. 6, (Portland, 1860). South Carolina. Name only.

SIPHONODENTALIUM LOBATUM Sowb. (p. 136).

Add the synonym *Siphonodentalium exvitreum* SACCO, Moll. Terr. Terz. Piem. e Ligur., xxii, 1897, new name for *D. vitreum* Sars not Gmel.

New British localities for *S. lofotense* and *S. affine* are recorded by Marshall, Journ. of Conch., ix, p. 61, 62.

Section DISCHIDES Jeffr. (p. 143).

Add synonym *Dicides* SACCO, t. c., p. 115.

Section GADILA Cray.

CADULUS ANGUIDENS Melvill & Standen. Pl. 39, fig. 4.

Shell a little arcuate, tapering toward the apex, pellucid white. Aperture rounded-ovate, the margin oblique; posterior orifice

small, round, simple and thin. Length 8, diam. at mouth 1, at apex 0·5 mill. (*M. & S.*).

Madras (Henderson).

Cadulus anguidens M. & S., Journ. of Conch., ix, p. 32, pl. 1, f. 6 (January 1, 1898).

"A graceful, attenuate, slightly arcuate *Cadulus*, gradually increasing in diameter till the oblique aperture is reached. The shell is subpellucid, white, quite smooth; posterior or apical orifice minute, simple, round, thin, the mouth being roundly-ovate, with very oblique margin. Two specimens, differing from any in the national collection" (*M. & S.*).

(*Fossil species of Dentalium*).

D. ANGULARE Kaunhowen, Die Gastropoden der Maestrichter Kreide, in Palæontologische Abhandlungen (n. F.) iv, Heft 1, p. 13, pl. 1, f. 1, 1a (1897).

Cretaceous, Maestricht.

D. CATULLOI Vinassa, 1896. Boll. Soc. Geol. Ital., xv, p.

Lower Miocene, Italy.

D. COSTARICENSE Pilsbry, 1898. Proc. Acad. Nat. Sci. Phila.

D. dentale GABB, Journ. A. N. S. Phila. n. ser., viii, p. 369 (in part).

Pliocene: Costa Rica.

D. HEXAPLEURON Kaunhowen, Die Gastr. der Maestr. Kreide, Palæont. Abhand. (n. F.) iv, Heft 1, p. 13, pl. 1, f. 2, 2a (1897).

Cretaceous, Maestricht.

D. MACILENTUM Pilsbry, 1898. Proc. Acad. Nat. Sci. Phila.

Oligocene: Bowden, Jamaica.

D. SCHUMOI Pilsbry, 1898. Proc. Acad. Nat. Sci. Phila.

Oligocene: *Bowden, Jamaica.*

D. GEINITZII (J. Böhm) 1885.

Fustiaria geinitzii J. BOHM, Der Grünsand von Aachen und seine Molluskenfauna, p. 34, pl. 1, f. 7 (1885).

D. glabrum MULL., Monographie, ii, p. 5.

Entalis geinitzii Böhm, HOLZAPFEL, Moll. Aachener Kreide, Palæontographica, xxxiv, p. 177, pl. 20, f. 11 (1887).

Cretaceous, Vaals and Aix-la-Chapelle.

D. GARDNERI (Holzapfel) 1887.

Entalis gardneri HOLZAPFEL, Moll. Aachener Kreide, in Palæontographica, xxxiv, p. 178, pl. 20, f. 10.

A smooth species of *Fustiaria.*

Cretaceous: Greensand at Vaals.

D. INFORTUNATUM Pils. & Sh., 1898. This name will replace *D. gardneri* S. & P. = *D. acuminatum* Gard., (p. 222), not of Holzapfel.

"Müller described from the Cretaceous of Aix-la-Chapelle, *D. cidaris, D. ellipticum* and *D. rugosum.* The last species is certainly not a Dentalium, but the internal cast of a *Gastrochæna* (?), of which the shell has not yet been observed, though the fossil is very abundant. What Müller understood to be *D. ellipticum* I cannot say, nor what he identified as *D. cidaris.* In Müller's collection there is a piece of chert containing the impression of the anterior end of a *Cidaris* spine with the label *Dentalium cidaris* Gein." (*Holzapfel,* Palæontographica, xxxiv, p. 179).

CADULUS AQUENSIS (Holzapfel), 1887.

Gadila aquensis HOLZ., Palæontographica, xxxiv, p. 179, pl. 20, f. 8.

Cretaceous: Greensand of Vaals.

INDEX TO SCAPHOPODA.

[Names of genera and other groups are in SMALL CAPITALS; those of valid species of Scaphopoda in Roman type; all synonyms and non-Scaphopod names are in *Italic* type].

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Order *APLACOPHORA* v. Ihering.

Aplacophora Ihering, Jahrb. d. Deutsch. Malak. Ges., 1876, p. 136 (as a Class of the Phylum *Amphineura*, of the Vermes); Vergleich. Anat. Nervensyst. u. Phylog. Moll., p. 31.

Telobranchiata Koren & Danielssen, Arch. Math. og Naturvid., ii, 1877, p. 123 (as an Order of Opisthobranchiata). See for translation, Ann. Mag. N. H. (5), iii, p. 323.

"Grade *Lipoglossa*, Class *Solecocmorpha*" [*Scolecomorpha*] Lankester, Quart. Journ. Mic. Sci. (n. ser.) xvii, p. 448 (1877).

Solenogastres Gegenbaur, Grundriss der Vergleich. Anat., (2d edit.), 1878. English trans. by Jeffrey Bell, p. 127 (Division of Vermes).

Orders *Neomeniæ* and *Chætoderma* Lankester, Encyclop. Brit. (Edit. 9), xvi, art. *Mollusca*, p. 641 (1883).

Vermiform Amphineura without calcareous plates along the back; covered with a spiculose integument, continuous around the body or interrupted by a longitudinal furrow beneath, in which lies the foot, which is much reduced or wanting; gills when present lying in a posterior cavity or cloaca, in which the anus opens. Gut not convoluted, with a blind sack or numerous lateral pouches apparently with the function of a liver. Pharynx with or without a radula, or with it represented by one conical tooth. Nervous system composed of four ganglion-bearing longitudinal trunks, two pedal and two lateral, the latter uniting posteriorly above the gut, and all uniting anteriorly in a circumœsophageal ganglionic ring.

The *Aplacophora* or *Solenogastres* escaped the notice of naturalists until about 1845, when Lovén described specimens collected by him under the name *Chætoderma nitidulum*. Subsequently M. Sars found but did not describe, another form which he called *Solenopus*, locating it in the Mollusca. It was not until 1875 that this animal was described and figured as *Neomenia carinata* by Hubrecht, who at first hesitated whether to place it with the Gephyrian worms or the mollusks. After this time the publications upon *Chætoderma*, *Neomenia* and related forms rapidly multiplied. The discovery of a radula in some of the genera influenced most investigators to consider the group molluscan; and the investigation of the nervous system which proved to show remarkable agreement with *Chiton*, soon caused the group to be located near the *Polyplacophora*. In 1890, Pruvot, at the Banyuls laboratory, studied the embryology of an Aplacophore, and ascertained that at one stage of development

it has a dorsal armor of seven slightly imbricating plates, exactly comparable with the seven-valved stage in the development of Chiton. This observation definitely fixes the position of the Aplacophores, as a degraded group of *Amphineura*, which had its inception in a Chiton-like ancestor, and has undergone reduction of the foot and dorsal armor by living in mud at depths below wave disturbance.

The simplification of the digestive tract in Aplacophores has doubtless been a secondary modification, due, as Simroth holds, to the adoption of a carnivorous diet; but the posterior gills, reduced to a single pair (for the numerous gill folds of *Neomenia*, etc., are not true ctenidia), the spiculose integument and the nervous system, are doubtless primitive structures inherited from polyplacophorous ancestors.

There is considerable diversity in habits and mode of life among the forms now known. *Chætoderma*, *Neomenia*, *Proneomenia* and *Ichthyomenia* are free-living forms, lying imbedded in mud, head downward, like a *Dentalium*, selecting their food of organic particles from the surrounding ooze. *Rhopalomenia*, *Nematomenia*, *Lepidomenia*, etc., are parasitic upon Hydroids, Gorgonians and Corals, upon the branches of which they crawl and coil themselves.

It is likely that future search will reveal Aplacophores in all seas, those at present known being a mere fragment of the existing fauna.

I am informed by Prof. A. E. Verrill that no less than six species of three or four genera, including *Neomenia*, occur in the Fish Commission collections off the eastern U. S. They are still unpublished.

The best general account of the anatomy of the group is that of Simroth in Bronn's Klassen und Ordnungen des Thier-Reichs, Vol. III. The memoirs of Wirén, Pruvot, Thiele, Kowalevski and Marion and Hubrecht, are the most important special treatises upon the subject.

Development.

Pruvot (Comptes Rendus cxi, p. 689–692, 1890) has observed the development of *Myzomenia banyulensis*. A brief summary of his observations is as follows:

The eggs are globular, and laid singly, few at a time. Segmentation begins an hour after they are laid, proceeding rapidly, and

is unequal from the first. The mode of segmentation resembles that of *Dentalium* and many Lamellibranchs. After 24 hours there appears a median corona of vibratile cilia, while two ciliated areas appear at the cephalic pole and the point of invagination respectively. The embryo elongates and becomes divided by two annular constrictions into three segments. The cephalic segment is formed of two rows of ciliated cells; some of the cilia become longer than the rest, and one finally becomes much larger, and forms the terminal flagellum. The second segment or velum is formed of a single layer of cells, which have a single row of cilia; these grow and form the ciliated corona, the chief organ of locomotion. The third or pallial segment is formed of two rows of cells which are entirely covered by fine cilia (pl. 48, fig. 5, larva of 36 hours). In a larva of 100 hours (pl. 48, fig. 6) three imbricated spicules are to be seen on either side of the ventral line, still enclosed in their mother-cells. The spicules increase in number. The conical body elongates rapidly and becomes curved on its ventral surface, while the mantle is gradually reduced, and the embryo falls to the bottom, as the ciliated corona is unable longer to support it in the fluid.

Only one of the embryos passed safely through the critical period of metamorphosis, which is on the seventh day. This change consists in the casting off of almost the whole of the external envelope of the larva, that is to say, of the cells of the velum and the two rows that form the pallial lobes. Seven dorsal calcareous and slightly imbricated plates were observed in the surviving embryo (pl. 48, fig. 7, plates seen along the right margin).

Classification.

The *Aplacophora* present two divisions of unquestionably higher rank than families.

Suborder I. *Chætodermatina* Simroth (=Ord. *Chætoderma* Lank.). Spiculose integument continuous all around the body. Family *Chætodermatidæ*, p. 284.

Suborder II. *Neomeniina* Simroth (=Ord. *Neomeniæ* Lank.). Spiculose integument interrupted beneath by a longitudinal ventral furrow. Family *Neomeniidæ*, p. 288.

In the present condition of knowledge it would seem inadvisable to recognize more than one family in each of the suborders; but it should be mentioned that Simroth (in Bronn, p. 225) suggests, but does not adopt, a division of the *Neomeniidæ* into four families, thus:

NEOMENIIDÆ, *Neomenia*; PRONEOMENIIDÆ, *Proneomenia, Solenopus, Rhopalomenia, Macellomenia*; DONDERSIIDÆ, *Dondersia, Myzomenia, Nematomenia*; PARAMENIIDÆ, *Paramenia, Ismenia, Lepidomenia, Echinomenia.*

Thiele (Zeitsch. wiss. Zool., lviii, 278) suggests splitting the Neomeniidæ into two families: NEOMENIIDÆ to contain the genera *Proneomenia, Rhopalomenia, Pruvotia, Neomenia* and *Paramenia,* and MYZOMENIIDÆ for *Macellomenia, Dondersia, Myzomenia, Nematomenia, Ismenia, Lepidomenia,* and *Echinomenia.* The distinction is based largely upon features of the cuticular layer.

Family *CHÆTODERMATIDÆ.*

Body elongated, vermiform, the mouth and cloaca terminal; head defined by a constriction; body cylindrical, clothed with spiculose cuticle all around, without a foot-groove ventrally. Two well developed feather-like gills; genital openings separated, the genital ducts also functioning as nephridia. Sexes separated; no copulating organ. Radula reduced to a conical peg of conchiolin. Mid-gut with a posteriorly lying blind sack acting as a liver.

Genus CHÆTODERMA Loven, 1845.

Chætoderma LOVEN, Ofversigt of Kungl. Vet. Akad. Förh., i, p. 116.—*Crystallophrysson* MOBIUS, 1875.

Characters those of the family. Spicules alike all around the body, of needle-shaped and flat forms.

Chætoderma lives upon mud bottom, mainly at a depth of 20 to 40 meters. It burrows in the mud, so that the dredge must be weighted to secure them. Wirén writes as follows of specimens kept by him in an aquarium, the bottom of which was covered by a layer of mud:

"When they were not disturbed they remained throughout the day almost motionless in a perpendicularly descending burrow, the anterior end directed downwards, the posterior upwards. The upper mouth of the burrow was completely closed by the wider bell-shaped posterior end, so that from the surface one noticed only the upwardly directed points of the two red gills.

"When the animal was disturbed by the approach of any object to the gills, it instantly contracted and bored down several inches with extraordinary swiftness. It effected this progress by alternative lengthening and contraction of its body. In this the ante-

rior, most movable part of the body, as well as the great spines of the posterior end, played the leading part. These spines are so placed that in the contracted animal they converge backward, but in the expanded condition they diverge, pointing obliquely backward and laterally. When the animal expands these prickles must accordingly grip into the side walls of the burrow and thus lend support to the posterior end, preventing any movement upward of this end. Consequently, with each elongation the anterior end is pushed forward a distance equal to the difference in length between the extended and the contracted animal. In a great contraction the anterior part of the prothorax is swollen to a thick bulb, whereby the anterior part of the animal is apparently wedged in the burrow, the small spines of that end, which are directed obliquely to the side, affording insufficient support. The great spines of the hinder end at the same time become loosened from the walls of the burrow. With each contraction the hinder end draws itself forward without change in the position of the anterior end.

"I have never observed an animal which had burrowed deeply in this manner, come up in the same burrow in which it had descended. In order again to reach the resting position the animal must first bore upward and on reaching the surface, again bore downward. It describes, therefore, during its wanderings from the first resting position to the second, the curve represented in pl. 41, fig. 26. The animal proceeds a short distance on the surface, indeed, it sometimes crawls several inches, before it again bores downward. This is a very slow procedure and attended with considerable difficulty, the hinder part of the body swinging now to right, now to left, by means of alternating expansion and contraction. Generally, particularly on a slightly uneven surface, Chætoderma makes wholly irregular tracks; on even surfaces, however, and when the animal crawls straight forward, we obtain that peculiar regular appearance which the subjoined drawing (pl. 41, fig. 27) presents, which might easily convey to the paleontologist the idea of a plant impression.

"I have never seen *Chætoderma* performing swimming movements, nor has it seemed able to crawl up the walls of the aquarium. *It is wholly adapted to life in the slime bottom*, and the knowledge of this circumstance is of importance for the proper understanding of the organization of the animal in reference to its relationships with allied forms. *Chætoderma* does not devour sand or slime as many

worms which creep about in mud do. Its intestine is usually almost empty, its contents always consist of minute animal or plant organisms, principally of diatoms, sometimes also of foraminifera or other protozoans.

"When the animal remains undisturbed in its burrow, the upper mouth of the burrow, as has been mentioned above, is entirely filled up. Since *Chætoderma* lacks the abdominal groove present in all other Solenogastres, naturally none of the surface water finds its way to the mouth opening. Accordingly the animal cannot, as for example, is the case with the *Siphoniata* living in mud, feed upon organisms swimming about in the sea water, but must be limited exclusively to those found in the slime bottom. These are obtained, naturally, by means of the anterior end. Not only the strong and manifold movements of the prothorax, but also the occurrence of a peculiar sense organ, the mouth shield, has this function. This organ, for discussion of which we will have greater opportunity later, is not only an organ for digging and grubbing, but is certainly a sense organ also. It is not present in other known Solenogastres."

Synopsis of species.

a. Length of the body often exceeding 100 times the breadth (of the narrowest part). Mouth-shield convex. Dorsal sense-organ not covered by large spicules, surrounded on each side by a tract covered with numerous small spicules. Tongue posteriorly circularly closed, with large, lens-shaped thickenings of the cuticle at the sides. Each gill with three free lamellæ *C. productum.*

a'. Length of the body usually only 40–50 times the breadth. Mouth-shield flat. Dorsal sense-organ surrounded by a few rows of small spicules, and almost entirely covered with large spicules. Tongue open behind, no lens-shaped cuticular thickenings at the sides of the tongue. No free lamellæ on the gills *C. nitidulum.*

a''. Shorter and thicker. Spicules flat and elliptical anteriorly, further back becoming broad keeled spear-like points, and toward the posterior end long stout prickles *C. militare.*

C. PRODUCTUM Wirén. Pl. 41, figs. 16–26.

Length of largest specimens 130–140 mill., breadth of the prothorax 2, of the metathorax 1–½, of the abdomen 3–2 mill. Much

attenuated, especially the metathorax, which forms about two-thirds the entire length. Smaller individuals with more the proportions of *C. nitidulum;* in one about 70 mill. long, the prothorax measures 1½, metathorax nearly 1, abdomen 3 mill. in diameter. Mouth-shield (fig. 16) more convex than in *C. nitidulum.* Dorsal sense-organ (figs. 25, 26) longer, extending to margin of cloaca, having a wide area of short spicules on each side. Gills like those of *nitidulum,* but with not quite so many lateral lamellæ, scarcely 20 on each side. Tongue covered with a thick cuticle, which on each side of the tooth and a little backwards is strongly thickened, which is not the case in *C. nitidulum.* The tooth is almost wholly sunken in the radula sack. Internal structure not differing greatly from *C. nitidulum.*

Kara Sea (Djimnfa Exped.).

Chætoderma productum WIREN, Kongl. Svenska Vetenskaps-Akademiens Handlingar, xxv, art. No. 6, p. 8, pl. 1, f. 1–5, 8–16 (1892).—SIMROTH, Thier-Reich, p. 226, and p. 133, fig. 1.

C. NITIDULUM Lovén. Pl. 40, figs. 1–11, 13–15.

Large individuals 80 mill. long, 3 mill. wide in the middle; average length 30–50 mill. Body cylindrical, of a gray satin-like luster and color, the gills light blood-red or yellowish-red. Dorsal sense-organ (pl. 40, fig. 8), covered with long spicules.

West coast of Sweden; Norway; North Sea at Silverpit; Spitzbergen; Kara Sea, east coast of Nova Zemblia; Omenak, northern Greenland, 10 to 250 fathoms; *Casco Bay, Maine,* 48–64 fms. (Verrill).

Chætoderma nitidulum LOVEN, Ofversigt af Kungl. Vet. Akad. Förh., 1844, i, p. 116, pl. 2 (1845); Reprinted in Archiv Skandinavischer Beiträge zur Naturgeschichte, 1845, p. 169, pl. 2, and in Froriep's Neuen Notizen, xxxiv, 1845, figs. 43–43e.—KEFERSTEIN, Beiträgen zur anatomischen und systematischen Kenntniss der Sipunculiden, Zeitschr. f. wiss. Zool., xv, 1865, p. 442.—HANSEN, Anatomisk Beskrivelse af Chætoderma nitidulum Lovén, in Nyt Mag. for Naturvidensk. Christiania, xxii, pp. 354–377, pl. 1–5 (1877); Neomenia, Proneomenia und Chätoderma, Bergens Museums Aarsberetning for 1888, art. No. vi, p. 6 (1889).—GRAFF, Anatomie des Chætoderma nitidulum Lovén, in Zeitschr. für wiss. Zoologie, xxvi, pp. 166–192, pl. 11–13; Neomenia und Chætoderma,

Zeitschr. wiss. Zool., xxxiii, p. 568, f. 2 (1877).—Wiren, Histologiska meddelanden om Chætoderma nitidulum Lovén, in Biologiska Föreningens Förhandlinger, Stockholm, iii, pp. 37–49 (1890); Mittheilungen über den Bau des Chætoderma nitidulum Lovén, l. c. ii, No. 7, pp. 68–73; Monographie des Chætoderma nitidulum Lovén, in Kongl. Svenska Vet. Akad. Handl., xxiv, No. 12, pp. 1–66, pl. 1–7 (1892).—Simroth in Bronn, p. 226, pl. 1, f. 1–13.—Verrill, Explorations of Casco Bay, in Proc. Amer. Asso. Adv. Sci. xxii, 1873, p. 347, pl. 6, f. 6.—*Crystallophrysson nitens* Mobius, Jahresber. der Commission zur wissensch. Unters. der deutschen Meere in Kiel, ii, iii, Zool. Ergebnisse 5, Vermes, p. 157, pl. 3, f. 6–12 (1875).

Verrill reports this species as common in 10 to 100 fathoms, muddy bottom, off northern New England and Nova Scotia.

C. militare Selenka. Pl. 40, figs. 12, 16, 17, 18.

The calcareous spicules of the proboscis are in the neighborhood of the mouth (fig. 16) *flat and elliptical;* further back they are larger and have the form of shovel-like or tongue-like plates (figs. 17,), and finally they gradually become smaller again and take the form of *keeled* spear-like points. *The body proper bears only a few thinly scattered* rounded calcareous plates, but at the posterior end there are again large plates, which towards the anus become long stout prickles, with a cross-section between circular and elliptical. Round about the anus are numerous small prickle-like or awl-shaped calcareous needles (fig. 12).

East of Panay, Philippines, Lat. 9°, 26′ N., Long. 123° 45′ E., 375 fms. in blue mud.

Chætoderma militare Selenka, Chall. Rep., Vol. xiii, Report on the *Gephyrea*, p. 23, pl. 4, f. 28–32.—Simroth in Bronn, pl. 1, f. 14, 15.

Fig. 18 shows the animal natural size. Description and figures from Selenka.

Family *NEOMENIIDÆ.*

Body bilaterally symmetrical. Head and cloaca not defined from the body, or but slightly so. Mouth subterminal on the ventral side when the animal is at rest, the cloaca-opening similarly situated or terminal. Ventral groove provided with a foot-ridge, or at least a longitudinal strip desitute of cuticle; foot-gland present. Gills

developed as simple folds of the circum-anal border, never feathery. Hermaphroditic. Genital ducts uniting into one median opening below the anus. As nephridia act apparently certain pre-anal glands which open into the cloaca. Radula of the usual kind, or entirely wanting. Mid gut without blind sac, with numerous lateral pouches. Animal living free or parasitic.

[NOTE.—The "preliminary notice" reigns supreme among the "morphologists," nearly every paper upon Solenogastres having been preceded by one or more of these troublesome notes. No species monger ever carried the struggle for priority to the extreme ordinarily met with in the literature of this group. The genera *Rhopalomenia*, *Macellomenia*, *Nematomenia*, *Myzomenia* and *Echinomenia*, and the species *Proneomenia langi*, were proposed in the new edition of Bronn's Thier-Reich and in Zeitschrift für Wissenschaftliche Zoologie, lvi, pp. 322–325, 1893, nearly simultaneously. In the text I have cited Bronn only, as that has probable priority of publication, though the other paper may have been prepared first.

Pruvot's genera and species were briefly diagnosed in Arch. Zool. Expér. et Génér. (2), viii, p. xxii, xxiii, prior to the publication of his elaborate and excellent work of the following year].

Genus NEOMENIA Tullberg, 1875.

Neomenia TULLB., Bihang k. Sv. Akad. Handl., iii, No. 13 (1875).—WIREN, K. Sv. Vet. Akad. Handl., xxv, p. 15.—*Solenopus* M. SARS, Forh. Videns. Selsk. Christiania, 1868, p. 257 (name only, no description).—KOREN & DANIELSSEN, Archiv for Math. og. Naturvid. Christiania, 1877, p. 6.

Body short, plump, similarly shaped at the two ends, cloaca subterminal, the foot-groove continued to it (except in *N. grandis*) with 7–13 longitudinal folds within; a rudimentary sole present. Integument with a simple layer of spicules, part of them grooved, part needle-shaped, projecting well from the cuticle between large, several-celled papillæ. A circle of short branchial folds around the anus. Mouth terminal, with numerous thread-like cirri; no radula or salivary glands; pharynx protrusible. A copulating organ generally developed. Type, *N. carinata*.

The most extensive and elaborate work upon this genus is that of Axel Wirén, cited above. Simroth has given a good synopsis in the new edition of Bronn. Wirén gives the following observations upon the habits of *N. carinata*:

"The Neomeniæ inhabit preferably rather deep water; apparently they generally live on muddy bottom. They differ widely as well in habits as in station from the more elongated Neomeniens of the Mediterranean, which live upon narrow fixed objects, Hydroids, Gorgonians, roots of Algæ, etc.

"Koren and Danielssen who have observed *Neomenia carinata* (?) in the living state, assert that, by throwing the margin of the mantle to one side so that the foot becomes visible, it is able to creep up the sides of the aquarium 'like other mollusks;' indeed, that it is able to swim on the surface of the water with the curved foot upward and the back down. As has been already indicated, it may be doubted whether the animal observed by Koren & Danielssen was in reality *Neomenia carinata*. The facts cited above appear highly improbable, and may prove to be erroneous. What is one to understand by the statement that *Neomenia* creeps with great rapidity like other mollusks, considering that mollusks as a rule cannot boast of great speed—the snail's pace having always served as the type of the slowest progress—it appears improbable that *Neomenia* should be distinguished by this characteristic—*Neomenia*, in whose so-called foot there is no muscular fiber and in whose body walls but a weakly developed musculature, and which never possesses an abdominal disk suitable for creeping. Moreover no other *Neomenia* has been observed to move at other than an unusually slow pace.

"I myself observed not many years ago a *Neomenia carinata* which was kept for some days in a vessel of water. I observed no other movements than an opening and closing of the mantle opening, an alternating extension and retraction of the proboscis, and a contraction of the body into an arched form with subsequent extension so that it became almost entirely straight. During the entire time the animal remained quietly in the same spot.

"Prof. Tullberg similarly kept for some days living *Neomenia carinata* in a vessel of water, and during this time observed no other movement than the opening of the cloaca.

"Prof. Théel, who observed during a longer period, a living individual in an aquarium, the bottom of which was covered with sand, informed me that the animal when undisturbed remained motionless, buried in the sand in a vertical position, so that only the mouth of the cloaca and gills were visible. If the animal was removed it bored directly down again until the old position was reached. No voluntary change of position was observed. From these observa-

tions I gather that *Neomenia carinata* resembles *Chætoderma* in habit. The latter lives in the soft bottoms, in which it rests with posterior end up and anterior down, so that the mantle opening is at the same level as the surface of the ground. Apparently *Neomenia* bores into the above described position by help of its protrusible proboscis, the only part of the body provided with a powerful musculature.

"In all the *Neomeniæ* which I examined, the intestine was almost empty. In no case did it contain sand or mud, and identifiable particles were never found. The *Neomenias* feed, as does *Chætoderma*, not upon mud, but upon organic particles, which alone are taken into the alimentary canal. It is impossible for *Neomenia* to find and seize these particles separately by means of its large and unwieldy proboscis, although it is extensible. The food is obtained by the action of the cirri in the mouth, which remind one in a great measure of the cirri of the *Scaphopoda*, although the corresponding organ in *Neomenia*, in case that my animal has not been injured, is apparently shorter in the extended condition.

"Observations on habits have been made on *Neomenia carinata* only. The other species are entirely unknown in this respect. *Neomenia affinis* and *microsolen* are very similar to *N. carinata*, and similarity in habits may, therefore, be inferred. *Neomenia Dalyelli* may show greater variation in regard to habit, since it lacks the penis and as it appears, the protrusible proboscis."

* *Body keeled dorsally.*

N. CARINATA Tullberg. Pl. 42, figs. 1–9.

Length (in contracted state) 8–30 mill. Body curved into a half moon shape when contracted, compressed above into a dorsal keel, which is scarcely one-fifth the height of the body. Light gray, with a shade of rosy red around the anus. Spicules small, 0·1 mill. long, simple and needle-like on the sides, but channelled and with arrow-like points on the back, stomach folds 9, branchial folds 40–45. Copulating organ present.

West coast of Sweden, 60–200 fms.; Shetland Islands.

Solenopus nitidulus M. SARS, Forh. i Videnskabs-Selskabet i Christiania, 1868, p. 257 (name only, no description).—KOREN & DANIELSSEN, Archiv for Mathem. og Naturvidenskab. Christiania, 1877, p. 6 (trans. in Ann. Mag. N. H. [5], iii, p. 324).—*Neomenia carinata* TULLBERG, *Neomenia*, a new genus of Invertebrate Ani-

mals, Bihang till K. Svenska Vet. Akad. Handl., iii, No. 13, pp. 1–12, pl. 1, 2 (1875).—Hansen, Neomenia, Proneomenia und Chätoderma, Bergens Museums Aarsberetning for 1888, art. vi, pl. 1, f. 1–7.—Norman, Ann. Mag. N. H. (5), iv, p. 165 (1879).—Simroth in Bronn, p. 227, pl. 2, f. 1–13.—Wiren, Studien über die Solenogastren II, Chætoderma productum, Neomenia, Proneomenia acuminata, in Kongl. Sv. Vet. Akad. Handl., xxv, art. 6, p. 15, etc., pl. 1, f. 17–20; pl. 2, f. 3, 7–9; pl. 3, f. 1–8, 11–14; pl. 4; pl. 5, f. 7; pl. 6, f. 2, 3, 5–9, 12, 14, 15, 17; pl. 7; pl. 8; pl. 9, f. 1–4, 11–13; pl. 10, f. 30, 31.—Pruvot, Organization de quelques Néoméniens, in Arch. Zool. Expér. et Génér. (2), ix, p. 728.—Graff, Neomenia u. Chætoderma, in Zeitschr. f. wiss. Zool., xxviii, p. 557, f. 1 (1877).—Garstang, Proc. Malac. Soc. Lond., ii, p. 124, f. 2.

N. affinis (Koren & Danielssen). Pl. 42, figs. below 6 and 7.

Dorsal keel distinctly defined at base, high, fully one-third the height of the body; spicules as in *N. carinata;* anatomy unknown. Length 16, width 6, height 6 mill.

Messina 20–30 fms.; *Genoa.*

Solenopus affinis Kor. & Dan., Beskrivelse over nye arter, henhorende til slægten Solenopus, samt nogle oplysninger om dens organization in Archiv for Mathem og. Naturvidenskab, ii, 1877, p. 127.—*Neomenia affinis* Wiren, Kongl. Sv. Vet. Akad. Handl., xxv, No. 6, p. 15, pl. 1, f. 21; pl. 2, f. 4, 10.—Simroth in Bronn, p. 227.—Pruvot, Arch. Zool. Exp. et Gen. (2), ix, p. 728.

Internal anatomy not yet investigated. Differs from *N. carinata* in the much greater height of the dorsal keel.

N. grandis Thiele. Pl. 42, figs. 10–16.

Back keeled, the keel reaching to the mouth, where it is widened. Ventral surface somewhat flattened, the ventral groove commencing just back of the anterior end, with a furrow along each side of it, defining two lips, the furrows meeting just in front of the cloaca, folds of the ventral groove 13, decreasing to 5 behind. Gill folds 42. Cloaca situated ventrally behind, appearing as a longitudinal crevice. Spicules (figs. 13, 14) long or short, needle-like or guttered, those upon the cuticle inflected, in the anterior part of the mouth small, lancet-shaped (fig. 11).

Length about 40, breadth 10, height 8 mill.

Naples.

Neomenia grandis Thiele, Zeitschr. für Wissensch. Zool., Vol. 58, p. 223, pl. 12, f. 1–50 (1894).

* * *Body rounded, not keeled dorsally.*

N. DALYELLI (Koren & Danielssen). Pl. 41, figs. 28–31.

Body circular in section, not keeled, spicules (fig. 28) large, 0·2 mill. long, those of needle-shape as long as the guttered ones. A large spicule on each side of the cloaca. No digitiform glands; stomach folds 9; gill folds about 40. No organ of copulation. Length 20, width in the middle 7 mill.

Coast of Norway, 2–300 fms.; *North Atlantic, lat. 64° 9′ N., long. 6° 6′ E.*, 157 fms.; *Scotland?*

Solenopus dalyelli KOR. & DAN., Archiv for Math. og Naturvidensk., ii, p. 127 (1877), trans. in Ann. Mag. N. H. (5), iii, p. 327. —*Neomenia dalyelli* NORMAN, Ann. Mag. N. H. (5), iv, p. 165.—WIREN, Kongl. Sv. Vet. Akad. Handl., xxv, p. 16, pl. 1, f. 22; pl. 2, f. 6, 11–15; pl. 3, f. 9; pl. 5, f. 1–6, 8–11; pl. 6, f. 4, 10, 11, 16; pl. 9, f. 5–10.—PRUVOT, Arch. Zool. Expér. et Génér. (2), ix, p. 728.—SIMROTH in Bronn, p. 227.—GARSTANG, Proc. Malac. Soc. Lond., ii, p. 124.

?*Vermiculus crassus* DALYELL, Powers of the Creator, ii, p. 88, pl. 10, f. 11.

N. MICROSOLEN Wirén. Pl. 41, figs. 32–35.

Body laterally compressed, higher than broad (?); spicules small, the gutter-shaped and part of the needle-shaped ones 0·075 mill. long, part of the needle-shaped only half that length. No large cloaca spicules. Ventral furrow smaller than in the above species, with 7 ventral folds. Gills 35.

Santa Lucia, West Indies, 160 fms.

Neomenia microsolen WIREN, Kongl. Sv. Vet. Akad. Handl., xxv, no. 6, p. 16, pl. 1, f. 23; pl. 2, f. 5, 16; pl. 3, f. 10; pl. 6, f. 1.—SIMROTH, in Bronn, p. 227.

Genus PRONEOMENIA Hubrecht, 1880.

Proneomenia HUBRECHT, Zool. Anzeiger, iii, no. 70, p. 589.

Body elongated, vermiform, the length 9–14 times the diameter, tapering behind. Cloaca opening ventral. Foot present, the foot groove passing into the cloaca. Cuticle thick with crossed spicules. No gills. Radula multidentate. Two salivary glands. Penis wanting, numerous calcareous spicules functional as excitation organs. Type *P. sluiteri.*

P. SLUITERI Hubrecht. Pl. 43, figs. 17–22.

Body, in the preserved condition, stiff and light brown, cylindrical, thicker toward the anterior extremity; integument densely beset with spicules (fig. 21) placed at right angles to each other, and about 0·2 mill. long, shaped like elongated cones, pointed at one end, truncated at the other. Radula (fig. 22) multiserial. Length 105–148 mill., about 14 times the breadth.

Barents Sea, 110–160 fms.

Proneomenia sluiteri HUBR., Zool. Anzeiger, iii, no. 70, p. 589 (1880); Niederländisches Archiv für Zoologie, Supplementband, i, pp. 1–75, pl. 1–4.—PRUVOT, Arch. Zool. Expér. et Génér., (2), ix, p. 731.—SIMROTH, in Bronn, p. 228, pl. 3, f. 1–16.

Var. LANGI Simroth. Pl. 43, figs. 23, 24.

Animal having a neck-like constriction behind the anterior end; breadth somewhat greater compared with the length. Length 98, greatest height and breadth 10 mill.; least height 8, least breadth 6 mill., mouth 4 mill. long, the ventral groove beginning 1 mill. behind it; cloaca 6 mill. from hind end of ventral groove and 2 mill. long. A smaller specimen had a length of 75, greatest height 10, greatest breadth 9½ mill.

Northern part of Olga Strait, between König Karls Islands, Northeastland and Barentsland, 70–80 fms.

P. sluiteri HEUSCHER, Vierteljahrisch. Naturforsch. Gesell. Zürich, xxxvii, 1892, pp. 148–161, figs. 1–4; Jenaische Zeitschr. für Naturwissensch., xxvii, p. 476 to 512, figs. 1–4 and pl. 20–23—(Quart. Journ. Roy. Mic. Soc., 1893, p. 313; 1892, p. 771).—LANG, Lehrbuch der Vergleich. Anat., p. 569, fig. 386; and H. M. & M. Bernard's translation, Text-book of Comp. Anat., pt. 2, p. 3, f. 2.—*P. langi* SIMROTH in Bronn, p. 228.

Doubtfully distinct from *P. sluiteri*.

P. AUSTRALIS Thiele.

Similar to *P. sluiteri*. Cuticle 0·33 mill. thick, beset with spicules of the usual form, mostly hollow; those near the cloacal opening with the points bent toward the middle; in immediate proximity to the cloaca are very numerous smaller spicules, which are also frequently bent hook-like; to the right and left is a flat excavation, clothed with cuticle and these spicules. The dorsal posterior sense organ is also surrounded with small spicules. Ventrally runs the

ciliated longitudinal groove, anteriorly expanded, containing 5 longitudinal folds in front, then three, of which the two lateral ones unite posteriorly with the median. Radula small, with two rows of teeth, each tooth rather straight, long-conic, somewhat over 0·2 mill. long. There are 13 rounded receptacula seminis on each side. Length 90, diameter anteriorly 5 mill.

Northwest coast of Australia, 60 fms. (Gazelle Exped.).

Proneomenia australis Thiele, Zool. Anzeiger, xx, p. 399 (1897).

Differs from *P. sluiteri* mainly in the biserial radula and numerous receptacula seminis.

P. incrustata (Koren & Danielssen).

Body cylindrical, 30 mill. long, 3 broad, pointed towards the anterior, truncate at the posterior extremity; strongly incrusted with particles of sand, so that it has a rugged appearance. Mantle destitute of the spear-shaped calcareous spicules along the back.

Hasvig, Finmark, 200–300 fms.

Solenopus incrustatus K. & D., Beskrivelse over nye arter henhörende til Slægten Solenopus, samt nogle oplysninger om dens organisation, in Archiv for Mathematik og Naturvidenskab, ii, p. 128 (1877). Trans. in Ann. Mag. N. H. (5), iii, p. 328.—*Proneomenia incrustata* Hansen, Bergens Mus. Aar., 1888, p. 4, and of Pruvot and Simroth.

Known only by the above insufficient description.

P. borealis (Koren & Danielssen).

Body cylindrical, 25 mill. long, 3 broad, rounded and rather narrower at the anterior end, truncate at the hinder extremity, and incrusted with sand. Along the whole of the back runs a rather fine but sharp line, which is but slightly elevated and richly beset with short, thick, needle-shaped calcareous spicules.

Lofoten, etc., Norway, 40–400 fms.

Solenopus borcalis K. & D., *l. c.*, p. 128; Ann. Mag. *t. c.*, p. 328.—*Proneomenia borealis* Hansen, *l. c.*, p. 4.

Known only by the original description, translated above.

P. filiformis Hansen.

Animal 61 mill. long, 0·75 mill. thick; anterior end rounded; posterior end obliquely truncated (*Hansen*).

Sweden.

Proneomenia filiformis HANSEN, Bergens Mus. Aarsberetning, 1888, no. 6, p. 10.

Simroth and Pruvot simply repeat Hansen's brief diagnosis. The specimen is unique in the Bergen Museum, and has not been cut, so that the internal features are still unknown.

Subgenus *Amphimenia* Thiele, 1894.

Amphimenia THIELE, Zeitschr. f. Wissensch. Zool., lviii, p. 273, 244.

Radula uniserial; having gullet glands and lobed salivary glands; spicules of two forms; cloaca simple. Type *P. neapolitana.*

P. NEAPOLITANA Thiele. Pl. 43, figs. 25, 26, 27, 28.

Body elongated, round, with very strong integument, bearing two kinds of spicules: some small, hollowed, tapering to a point at each end, usually somewhat curved, and others considerably larger, pointed at one end only, being rounded at the other or running out in a sharp margin (fig. 26, 27). The smaller spicules lie tangential or obliquely in the cuticular layer, the larger ones perpendicular, with projecting points (fig. 25). Ventrally the latter sort fails, and the smaller ones become perpendicular. Ventral groove with a rather narrow median fold, a smaller one on each side of it, bordering the spiculose cuticle; wholly disappearing before it reaches the cloaca; in the space between them lies a preanal gland, below the hypodermis. Radula with one row of teeth, each tooth rounded in the middle in front, tapering at the sides, narrowed behind and running out in two rather long and acute points, which overlie the following tooth (fig. 28). Cloaca small. No copulating organ or penis spicules. Length about 30, diam. 1·5 mill.

Naples.

Proneomenia neapolitana THIELE, Zeitschr. f. Wiss. Zool., 1889, xlix, p. 429 (footnote); *l. c.*, p. 392 (no name); Biol. Centralbl., xi, p. 725.—*P.* (*Amphimenia*) *neapolitana* THIELE, Zeitsch. Wiss. Zool., lviii, p. 244, pl. 14, 15, f. 51–94.

Subgenus SIMROTHIELLA Pilsbry, 1898.

Solenopus (in part) KOREN & DANIELLSEN, Arch. Math. og Naturvid., ii, p. 120.—SIMROTH, in Bronn's Klassen u. Ordnungen des Thier-Reichs, p. 228. Not *Solenopus* Schönherr, Curcul. Disp. Meth., p. 268, 1826.

Body elongated, vermiform. Length 8–23 times the breadth. Gills present in the form of longitudinal folds. Radula and two salivary glands present. Having single tube-shaped penes (?). Type *S. sarsii*.

This subgenus differs from *Proneomenia* in the development of gills.

P. MARGARITACEA (Koren & Danielssen).

Body round, thick, strongly glistening, pointed at the anterior end, truncated transversely posteriorly; 12 mill. long, 1½ mill. thick at the broader posterior end. Mantle covered with needle- and lancet-shaped spicules. Two tubular penes.

Hvidingsöerne, Stavanger, Norway, 40–60 fms.

Solenopus margaritaceus KOR. & DAN. *l. c.*, p. 128 (trans. in Ann. Mag. N. H. (5), iii, p. 328).—SIMROTH, *l. c.*, p. 228.—*Neomenia margaritacea* PRUVOT, Arch. Zool. Expér. (2), ix, p. 729.—*Proneomenia margaritacea* HANSEN, Bergens Mus. Aarsberetning for 1888, p. 4.

P. SARSII (Koren & Danielssen). Pl. 43, fig. 29.

Body cylindrical, 70 mill. long, 3 mill. diam., the posterior [anterior] end transversely truncated, the anterior [posterior] end snout-shaped, extended.

Christianafjord, 100–200 fms.

Solenopus sarsii KOR. & DAN., *l. c.*, p. 128 (Ann. Mag. N. H. (5), iii, p. 328).—SIMROTH, *l. c.*, p. 228.—*Proneomenia sarsii* HANSEN, Bergens Mus. Aarsberetning for 1888, no. 6, p. 1–11, pl. 1, f. 8–10. —*Neomenia sarsii* PRUVOT, Arch. Zool. Expér. (2), ix, p. 729.

Fig. 29, one gill containing blood corpuscles. According to Hansen (*l. c.*, p. 10) the descriptions of the two ends of this species given by Koren and Danielssen should be transposed.

Genus RHOPALOMENIA Simroth, 1893.

Rhopalomenia SIMROTH, Klassen u. Ordn. des Thier-Reichs, p. 229.

Body vermiform, pointed in front and behind. Cloaca opening a ventral longitudinal slit, passing into the foot-groove. Foot present. Cuticle thick, enclosing obliquely crossed, needle-shaped spicules, pointed at each end, free from the epithelium; with club-shaped, narrow pedicled papillæ, projecting in the cuticle near to the surface. Gills wanting. Radula many pointed or wanting.

Salivary glands 2 ; penial exciting organs two or none. Length 6–60 mill., 6 to 25 times the breadth.

This genus is evidently composed of somewhat heterogeneous elements, which, however, share the peculiar shape and arrangement of spicules described above, and the same mode of existence, differing in both from the northern genus *Proneomenia*.

Thiele (Archiv Wiss. Zool., lviii, p. 273) proposes to restrict *Rhopalomenia* to the species *aglaopheniæ* and *eisigi*, and relegate *vagans*, *desiderata*, *gorgonophila* and *acuminata* to *Proneomenia*. I have, however, considered it advisable to leave the group within the limits fixed by Simroth, except that *sopita* is removed, as it obviously differs sufficiently to form another genus.

Key to Species of Rhopalomenia.

Cuticle papillæ	Exciting organs	Salivary glands	Radula	Gills	Length index	Species
one-celled	0	2	present	none	25	*gorgonophila*.
many-celled	2	2	present		6	*vagans*.
	0	2	present	none	6	*desiderata*.
			none	none	13	*aglaopheniæ*.

Of these species, the first is separated widely from the others by its peculiar cuticle-papillæ. The West Indian *R. acuminata* is still too little known to be included in the table.

R. GORGONOPHILA (Kowalevski). Pl. 44, figs. 30, 31, 32.

Elongated, cylindrical, winding around *Gorgonia* stems, upon which it is parasitic. Length 60 mill.

Algeria and Provence.

Neomenia gorgonophila KOWAL., Bull. Roy. Soc. Friends of Nat. Science, etc., 1881 (Russian) ; Zool. Anzeiger, iii, p. 190.—*Proneomenia gorgonophila* KOWAL. & MARION, Mém. Mus. Hist. Nat. Marseilles, III, p. 75, pl. 7, f. 18–21.—*Rhopalomenia gorgonophila* SIMROTH, Bronn's Thier-Reichs, p. 230, pl. 4. figs. 2–4.

Fig. 30 represents the animal in its natural position. Fig. 32 section showing foot-groove and foot. Fig. 31 section through the skin, showing epithelium above, below it the peculiar club-shaped inter-cuticular papillæ, and lower the horizontal spicules, with a layer of circular muscle beneath.

R. VAGANS (Kowalewski & Marion). Pl. 44, figs. 37, 38, 39.

Cylindrical, both ends similarly roundly-pointed. Cuticle homogeneous. Free living upon *Zostera*; 6 mill. long, 6 or 7 times the diameter.

Gulf of Marseilles.

Proneomenia vagans KOW. & MAR., Ann. Mus. d'Hist. Nat. Marseilles, iii, p. 29, pl. 3, 4, 5, 1887.—THIELE, Zeitsch. Wissensch. Zool., lviii, p. 258, pl. 15, f. 95–107.—*Rhopalomenia vagans* SIMROTH, *l. c.*, p. 230, pl. 5, figs. 1–7.

Fig. 38 shows the animal magnified 30 diameters, with the dorsal integument removed by the microtome, showing the intestinal coeca and (by transparence) the longitudinal salivary glands lying under them. Fig 39, ventral view of the hind end. Fig. 37, a spicule, x 510.

R. DESIDERATA (Kowalewski & Marion).

Body cylindrical, rounded at the two ends, 10 mill. long; cuticular layer relatively not very thick, formed of distinct layers, irregularly superimposed; cutaneous papillæ small, several-celled, for the most part not extending near the outer surface. Spicules all acicular, perceptibly curved. Radula well developed.

Marseilles, on *Posidonia.*

Proneomenia desiderata KOW. & MAR., l. c., p. 59, pl. 5, f. 28–34. —PRUVOT, Arch. Zool. Expér. et Génér. (2), ix, p. 732.—*Rhopalomenia desiderata* SIMROTH; *l. c.*, p. 230, pl. 4, fig. 5, 6.

R. AGLAOPHENIÆ (Kowalewski & Marion). Pl. 45, figs. 46–56.

Elongated, somewhat narrowed behind. Cuticle homogeneous. Frontal sense-tubercle retracted into the mouth cavity. Length 32 mill. Although the radula may be lacking, its supporting membrane and sheath remain. Parasitic.

Marseilles, Banyuls, Naples and Plymouth on *Aglaophenia.*

Proneomenia aglaopheniæ KOW. & MAR., Ann. Mus. d'Hist. Nat. Marseille, iii, p. 65, pl. 6, 7.—PRUVOT, Arch. Zool. Exper. (2), ix, pp. 720, 732, 760; Comptes Rendus, cxiv, p. 1211 (embryology).—*Rhopalomenia aglaopheniæ* SIMROTH in Bronn, p. 230, pl. 4, f. 7–16. —THIELE, Zeitsch. Wiss. Zool., lviii, p. 265, pl. 15, f. 108–114; pl. 16, f. 115–122.—GARSTANG, Proc. Mal. Soc. Lond., ii, p. 124, pl. 10, f. 3.

Fig. 50 shows the animal upon a branch of *Aglaophenia myriophyllum*. Fig. 53 shows one of the cuticular papillæ in section.

The specimens from Banyuls (pl. 45, figs. 46, 47, 53) examined by Pruvot may possibly belong to a distinct species, differing from typical *aglaopheniæ* in wanting the radula. They measure 30 mill. long, 2½ wide; color cream-white; form strictly cylindrical with no trace of a dorsal ridge or line. The caudal sensory knob is retractile, without a corona of spicules different from those of the general integument; it is the same with the cephalic knob (fig. 46). Always occurs coiled around *Aglaophenia myriophyllum*, in 60–80 meters depth.

R. EISIGI Thiele. Pl. 44, figs. 40–45.

Closely allied to *R. aglaopheniæ*. Length 25, diam. somewhat over 1 mill. A strong hump above the somewhat attenuated anterior end. Spicules similar to those of *aglaopheniæ*, but the largest seem to be more strongly curved, and the smallest have no hollow (figs. 40–42). A rudimentary radula sheath present. Salivary glands and genitalia as in *aglaopheniæ*.

Naples.

Rhopalomenia eisigi THIELE, Zeitsch. Wiss. Zool., lviii, p. 269, pl. 16, figs. 123–129 (1894).

Distinguished from *R. aglaopheniæ* by the hump on the head, etc. The ventral fold is sharper, and the epithelium of the mid-gut more strongly developed than in that species.

R. ACUMINATA (Wirén). Pl. 44, figs. 33–36.

Body 9 or 10 times as long as wide, rounded in front, pointed behind, in section triangular with rounded angles. Spicules lying mainly within the cuticle, 0·5 mill. long; those along each side of the ventral furrow standing radially, 0·25 mill. long. Radula very small, not occupying a cavity of the pharynx wall, composed of a basal membrane and transverse rows of rudimentary teeth (or low, transverse threads?). Dorsal sense-organ oval, cleft-shaped, situated about 2 mill. from the posterior end. Length 28½ mill., breadth about 3 mill.

Proneomenia acuminata WIREN, Kongl. Sv. Vet. Akad. Handl., xxv, p. 68, pl. 10, f. 1–29 (1892).—*Rhopalomenia acuminata* SIMROTH in Bronn, p. 231.

Genus NOTOMENIA Thiele, 1897.

Notomenia Thiele, Zool. Anzeiger, xx, p. 399 (see also Q. J. Roy. Mic. Soc., 1897, p. 527).

Small Solenogastres with moderately strong cuticle, club-shaped calcareous spicules and ventral ciliated foot-groove; fore-gut without a radula, with lobed salivary glands; mid-gut with lateral constrictions; efferent ducts of the gonads wholly separated and independent, with the receptacula seminis opening directly outward.

N. clavigera Thiele.

Animal about 4 mill. long, oval in section, rounded in front, blunt behind. Body-covering of moderately strong cuticle, from which project club-shaped, somewhat curved, transversely annulated spicules, which are about 60–100 micro-millimeters long and 12–15 thick; the annulation being produced by ring-shaped folds upon the inside of the hollow calcareous bodies. Ventrally a ciliated longitudinal furrow runs with one bluntly projecting fold; large glands, which lie in the neighborhood of the upper oesophageal ganglion, opening into the expanded anterior end.

The so-called mouth cavity is capacious, filled with numerous sensitive cirri. As well as can be seen, the fore-gut is separated off, as described for *Rhopalomenia*, and it seems to be formed as in this genus; without a radula, its sheath being perhaps represented by a ventral blind sack; two large, lobed, salivary glands; further backward the midgut has strong, regular lateral constrictions; behind, the gut contracts, and opens into the cloaca. No copulating organ.

Torres Strait, 20 fms. (Haddon).

Notomenia clavigera Thiele, Zool. Anzeiger, xx, p. 398 (1897).

Genus PRUVOTIA Thiele, 1894.

Pruvotia Thiele, Zeitsch. f. Wissensch. Zool., lviii, p. 272 (in text), type *Proneomenia sopita* Pruvot.

Similar to *Rhopalomenia*, but with no trace of a radula or salivary glands, and with a highly developed pre-anal gland.

P. sopita (Pruvot). Pl. 46, figs. 57, 58, 59.

Similar in size, arrangement of spicules and color to *R. aglaopheniæ*, but never living coiled around Hydroids, but always on *Sertulariella polyzonias*. In rest it is always at length along a branch, the head a little raised and the cloaca half open. The cloacal re-

gion is globose and separated from the rest of the body by a slightly marked groove, which disappears when the animal moves. Movement is very slow. There is no caudal sensitive knob; on the other hand, the cephalic knob shows good differences between this species and *P. aglaopheniæ*. Fig. 59 shows the ventral face, with the circumbuccal ridge, against which the fine tactile bristles stand, with, in the middle, the sensitive knob bearing four short, parallel rows of little foliated spicules, one on each side of the base and two on the summit, limiting three little clear spaces. Length of largest specimens 22 mill.

Banyuls, on *Sertulariella polyzonias*, in 45–70 meters depth.

Proneomenia sopita Pruvot, Arch. Zool. Expér. et Génér. (2), ix, pp. 721, 732, 764, pl. 30, f. 50; pl. 31, f. 84.—*Rhopalomenia sopita* Simroth, in Bronn, p. 230, pl. 5, f. 8–12.—*Pruvotia sopita* Thiele, Zeitsch. Wiss. Zool., lviii, p. 273.

Very similar to *Rhopalomenia aglaopheniæ*, differing in the absence of a caudal sense-papilla or knob, the supra-buccal papilla with four series of small lanceolate spicules, and the radula absent.

Genus MACELLOMENIA Simroth, 1893.

Macellomenia Simr., in Bronn's Thier. Reich., p. 231.—*Paramenia* Pruvot in part.

Body cylindrical, short, somewhat smaller in front, transversely truncated behind. Cloaca terminal. Foot-groove subobsolete, curving into the cloaca. Cuticle lacking papillæ, bearing shield-like scales narrowing into spines (pl. 46, fig. 62). A circle of gills present. Radula with many-pointed teeth (pl. 46, fig. 63, denticle shown at *d*). Two salivary glands. Two stimulation glands, without stimulating organs. Length four times the breadth. Type *M. palifera*.

M. palifera (Pruvot). Pl. 46, figs. 60–63.

Body yellowish-white, very stout, curving in a crescent shape, 8 mill. long when extended, and about 1 mill. wide, without real keel but with a median dorsal line formed by the converging spicules; the cloacal orifice large and transverse, broadly notched in the middle by the termination of the pedal groove, and with 18 yellowish, ciliated branchial folds (fig. 60). No projecting foot, the foot-groove subobsolete, rather shallow, and marked only by the difference of the spicules: there being on each side a band of long and flattened

spicules (fig. 61). Over the remainder of the body the extremely thin cuticle is beset with little spicules of a very characteristic form (fig. 61) like a round-bladed shovel, very densely placed, having the flattened end against the cuticle, the narrowed portion lying free. Radula multidentate, very small.

North of Port Vendres, on tube of *Myxicola infundibulum*, in 80 meters.

Paramenia palifera PRUVOT, Arch. Zool. Expér. et Génér., (2), ix, pp. 727, 790, pl. 31, f. 74–78; pl. 25, f. 4. *Cf.* WIREN, K. Sv. Vet. Akad. Handl., XXV, p. 17.—*Macellomenia palifera* SIMROTH in Bronn, p. 231, pl. 6, f. 1–4.

Genus DONDERSIA Hubrecht, 1888.

Dondersia HUBRECHT, Donders Feestbundel, etc., p. 324.

Body elongated, vermiform, cylindrical. Anterior end thickened, club-like. Cloaca opening ventral, the tail projecting above and beyond it finger-like. Foot-groove curving into the cloaca. Foot present. Spicules needle- and shovel-shaped. No gills. Radula present. Ventral and dorsal salivary glands. Length 10 times the breadth.

D. FESTIVA Hubrecht. Pl. 46, figs. 64–68.

Body narrow, pointed posteriorly, 10 mill. long, 1 mill. wide; violet colored. Spicules of two kinds: some acicular, others like a shovel or ladle. No caudal sensory organ. Radula much reduced. One pair of short salivary glands.

Gulf of Naples.

D. festiva HUBRECHT, Donders-Feestbundel Nederl. Tijdschr. Geneesk., 1888, p. 324–339.—PRUVOT, Arch. Zool. Expér. et Génér. (2), ix, p. 730.—SIMROTH in Bronn, p. 231, pl. 9, f. 1–6.

Genus MYZOMENIA Simroth, 1893.

Myzomenia SIMR., Bronn's Thier-Reichs., p. 231.—*Dondersia* PRUVOT, in part.

Elongated, vermiform, cylindrical. Extremities as in *Dondersia*. No foot. Foot-groove smoothed out, reduced to a ventral longitudinal streak (pl. 47, fig. 75). Spicules shield-shaped or leaf-shaped. shaped. No gills. No radula or radula sheath. Oesophagus long. Two salivary glands. A globular organ above the œsophagus. Length 30 times the breadth.

M. BANYULENSIS (Pruvot). Pl. 47, figs. 74–77.

Body much attenuated, 30 mill. long, 1 wide; brilliant reddish-purple, with silvery reflections due to the colorless layer of spicules, the young paler, somewhat orange, there being less red pigment, allowing the yellow color of the intestine to show through by transparence. Spicules of two kinds: wide and flattened (fig. 77) applied to the cuticle by the notched base, and imbricating regularly from below upward, over the entire surface; between them are irregularly placed club-shaped spicules (fig. 76), less numerous and on the ventral surface passing into a third type (76), which are winged, and form a row projecting on each side of the pedal groove, which is protected by their depression when the animal is contracted. There is a dorsal keel, formed solely by the converging spicules at the median line.

Coiled around stems of *Lafoea dumosa, Banyuls and Roscoff*, in 45–300 meters depth; also *Naples* (Thiele) *and Plymouth* (Garstang).

Dondersia banyulensis PRUVOT, Arch. Zool. Expér. (2), viii, p. 22; ix, p. 715, 777, pl. 25, f. 1; pl. 26, f. 8, 9; pl. 28, f. 20–33*a*; Comptes Rendus, cxiv, p. 1214—*Myzomenia banyulensis* SIMROTH in Bronn, p. 231, pl. 8, f. 1–13.—THIELE, Zeitsch. Wiss. Zool., lviii, p. 273, pl. 16, f. 132–143.—GARSTANG, Proc. Malac. Soc. Lond., ii, p. 124, pl. 10, f. 4.

Genus NEMATOMENIA Simroth, 1893.

Nematomenia SIMR., Klassen u. Ordn. des Thier-Reichs, p. 232.

Body proportioned like *Myzomenia*. Spicules leaf shaped. Radula wanting, its sheath present. Oesophagus short. *Four salivary glands.* Length 40 times the breadth.

N. FLAVENS (Pruvot). Pl. 47, figs. 78–82.

Externally similar in form to *Myzomenia banyulensis*, having the same cephalic "bib" of erect spicules (fig. 79), with fine tactile bristles along the whole buccal margin (fig. 79); the same dorsal carina formed entirely by the converging spicules, and the same more projecting border of spicules along the pedal groove. But the body is a beautiful citron-yellow from the shining through of the intestine. The tissues appear more delicate, the body less rigid, susceptible of being more closely coiled than the *Myzomenia*. The spicular covering resembles in general that of *M. banyulensis*, being composed of flat, upwardly imbricated spicules, very readily detachable from

the cuticle, on which they rest only by the bases; but these spicules are narrower, lanceolate (fig. 81, below), always notched at the base, with some sparsely scattered among them (fig. 81, above) of a club-shape; there are also all transition forms between these. The tail end (fig. 80) instead of being slightly narrowed as in *M. banyulensis*, is transversely truncated ventrally, prolonged dorsally in a short finger-shaped appendage. The sensitive organ, situated on the median dorsal ridge some distance from the lower end of the body (fig. 82) consists of a small hyaline prominence bristling with a great number of extremely fine tactile bristles, and encircled by a crown of very small lanceolate spicules. Length 40 mill., width 1 mill.

On *Lafoea dumosa*, at *Banyuls*, in 45–90 meters.

Dondersia flavens Pruvot, Arch. Zool. Expér. (2), ix, p. 718, 781; pl. 25, f. 2; pl. 31, f. 81.—*Nematomenia flavens* Simroth in Bronn, p. 232, pl. 6, f. 5–11.

Genus ICHTHYOMENIA Pilsbry, 1898, n. n.

Ismenia Pruvot, Arch. Zool. Expér. (2), ix, p. 719, 784, 1891. Not *Ismenia* King, 1850 (Brachiopoda) nor *Ismenia* Desv., 1863 (Diptera).

Body cylindrical-conic, broader behind, narrowed in front. Cloaca opening a terminal transverse slit, a prominence in front of it. Foot-groove and foot present, disappearing posteriorly. Cuticle not papillose, the ventral spicules leaf-shaped, the rest scale-like, imbricating. No gills. Radula well developed, apparently with two rows of teeth. Length 5 to 6 times the breadth.

I. ichthyodes (Pruvot). Pl. 46, figs. 69–73.

Body pale yellowish roseate, 12 mill. long, without a keel, but with a median dorsal line formed by the convergent spicules; pedal groove large (fig. 70); cuticle smooth, with leaf-shaped spicules (fig. 71) near the ventral sulcus, 0·06 mill. long and a third that breadth, outside of which is a wide band of strong spicules shaped like a paper-knife, 0·1 mill. long, covering and protecting the former; then follow spicules (fig. 73) of nearly the same form but smaller and striated; the rest of the surface with smaller discoidal spicules (fig. 72), which are very thin, with pectinated edge and a smooth, thick semicircular ridge. Their form and imbrication recall the ctenoid scales of fishes. The conspicuous peculiarity of the

animal is the large and strongly two-lipped cloaca, which looks like the mouth of a reptile or fish.

Off the mouth of the Tech, in 80 meters depth, among Bryozoa and Hydroids.

Ismenia ichthyodes Pruvot, Arch. Zool. Expér. (2), ix, p. 719, 784, pl. 25, f. 3; pl. 31, f. 79, 80 (1891).—Simroth in Bronn, p. 232, pl. 9, f. 7–11.

Genus PARAMENIA Pruvot, 1890.

Paramenia Pruvot, Arch. Zool. Expér. (2), ix, p. 786.—Simroth in Bronn, p. 232.

Body short, cylindrical, obliquely truncated behind. Cloaca terminal. Spicules partly needle-shaped, partly fish-hook-shaped (Pl. 47, figs. 87). Foot and foot-groove present, curving into the cloaca. Radula with two longitudinal rows of teeth. Length 5 to 6 times the breadth.

Two subgenera are recognized by Simroth, *Paramenia* and *Pararrhopalia.*

Subgenus Paramenia (restricted).

Cuticle thin, without sense-tubercles. Cloaca with a circle of gills. No excitation-bodies. Length six times the breadth.

P. impexa Pruvot. Pl. 47, figs. 83–87, 90.

Body cream-white, cylindrical, 12 mill. long, 2 mill. wide, transversely truncated, with 12–20 branchiæ around the cloaca; suprabuccal tubercle with two concentric coronæ of lanceolate spicules. Radula biserial.

P. impexa is a stout form, incapable of coiling itself, with cream-white, regularly cylindrical body, not keeled dorsally, rounded at the head end but truncated transversely by the cloaca (fig. 86). The pedal groove is well developed, as well as the foot, and is continued to the cloaca as a ventral sinus. The spicules of the general surface (fig. 87) are like those of *P. pruvoti*, but project a little less from the integument. The two sensory knobs of head and tail are very distinct, especially the latter (fig. 83), which is nearly cylindrical, very elevated, and bears, besides the usual corona of small lanceolate spicules a complete covering of little acicular spicules, very much crowded. The sensory knob of the head is distinguished

from that of other forms by its two concentric circles of foliated spicules (figs. 90).

Banyuls, among Hydroids and Bryozoa.

Paramenia impexa PRUVOT, Arch. Zool. Expér. et Génér. (2), ix, p. 724, 729, 786, pl. 30, f. 5; pl. 31, f. 64–73a, 82, 83.—SIMROTH in Bronn, p. 233, pl. 7, figs. 1–9.

P. SIERRA Pruvot. Pl. 48, figs. 8, 9, 10, 11.

Body somewhat yellowish-white, 12 mill. long, truncated transversely by the cloaca, which shows 28 roseate branchial folds; back with a many-lobed keel; spicules needle-shaped or hooked; cuticle rather thick, almost destitute of cutaneous papillæ. Radula biserial.

Known by one adult individual. Easily distinguished from the preceding by the very strong dorsal keel, which has about 20 somewhat irregular, laterally compressed lobes (fig. 8). The spicules resemble those of *P. impexa*, some being acicular (fig. 10) others hook-shaped (fig. 11), but they are larger. All around the pedal fossa they are radiating (fig. 9).

Off the Island of Pultelo, Spain, in 80 meters depth, on *Aglaophenia*, in company with *Proneomenia aglaopheniæ*.

Paramenia sierra PRUVOT, Arch. Zool. Expér. et Génér. (2), ix, pp. 725–788, pl. 25, f. 6; pl. 30, f. 61–63, 83.—SIMROTH in Bronn, p. 233, pl. 7, f. 10–14.

"*Solenopus*" *affinis* Kor. & Dan. resembles this in the high dorsal keel, but it is shorter, with the keel continuous.

Subgenus PARARRHOPALIA Simroth, 1893.

Pararrhopalia SIMR., *t. c.*, p. 232.—*Proneomenia* (in part) PRUVOT.

Cuticle thick, with club-shaped papillæ as in *Rhopalomenia;* no gills. Excitation body large. Length five times the breadth.

P. PRUVOTI Simroth. Pl. 47, figs. 88, 89, 91–93.

Body small, hardly 5 mill. long, generally compressed, bristling with spicules, mostly of the needle-shaped form, but some are fish-hook shaped. Supra-buccal sense tubercle small, with a tuft and a basal palisade of lanceolate spicules, caudal tubercle terminal, with many tactile bristles and a basal circle of lanceolate spicules. Penes exsertile, two. Radula produced, biserial (figs. 91, 93).

It is the most agile of the Neomenians, travelling about among the contents of the dredge, hydroids and bryozoans, without fixing upon any special host. The body is slightly yellowish-white, stout, and squarely truncated at the two extremities (fig. 92). The mouth relatively very large, the foot groove and foot well marked. At the cloaca end, in fully adult individuals, there are two long, slender bunches of straight penial spicules (fig. 92). The general covering of the body is characterized by the great number and large size of the spicules, which give it a particularly bristling appearance. Mainly acicular, and of the type represented by fig. 87, there are scattered, especially toward the tail, spicules of a barbed hook shape. The dorsal sensory knob is terminal, bristling with very numerous tactile hairs, and encircled by a regular, circular palisade of little lanceolate spicules (fig. 89). At the oral extremity there is another sensory knob in the middle of the buccal border, also showing a complete basal corona of little lanceolate spicules and an apical tuft of similar ones (fig. 88).

Banyuls, on sandy bottom with hydroids, 80 meters.

Proneomenia vagans PRUVOT, Arch. Zool. Expér. (2), ix, p. 723, pl. 25, f. 7, and pl. 31, f. 86, 87. Not of Kow. & Mar.—*Paramenia* (*Pararrhopalia*) *pruvoti* SIMROTH, *l. c.*, p. 232, pl. 6, figs. 12–17.

Genus ECHINOMENIA Simroth, 1893.

Echinomenia SIMROTH, Bronn's Thier-Reich, iii, p. 233.

Body elongated, vermiform, equal in breadth throughout its length, laterally compressed. Cloaca opening ventral. Foot and foot-groove present, curving into the cloaca; spicules are curved needles, truncated below, erectile; no gills. Radula biserial (?). Length 18 times the greatest diameter; height 3 times the width.

Differs from *Lepidomenia* in its compressed, elongated form, and the erectile spicules.

E. CORALLIOPHILA (Kowalevski). Pl. 48, figs. 94–98.

Animal 14–18 mill. long, living on red coral (*Corallium rubrum*) among the polyp bearing branches of which it crawls rapidly; sides and back covered with movable scales, which cause the color of the animal to change by their erection or depression, so that it may appear either whitish as the tentacles of the expanded polyp, or red like the stem. The naked ventral surface forms a creeping sole. Besides the scales, there is a bunch of straight spicules on the pos-

terior end in front of the anus. Of the internal organs, only the intestinal tract, a dorsal gonad and the four longitudinal nerve trunks typical of the Amphineura, were distinguished, the specimen being in bad condition (fig. 94). A second specimen of the same species was found at Marseilles by Kowalevski and Marion in 1882 and more exactly studied. The scales of this animal were not so moveable as those of *N. coralliophila*, but fast in the integument. Intestine and genital glands showed no constrictions, but formed two straight canals lying over one another. On the floor of the œsophagus a small radula was found, consisting of six pairs of hooklets; those of the forward three pairs were small and curved, the hind three pairs much larger and branching. Heart, uterus and oviduct resembled the corresponding organs in *Proneomenia*. In reference to the characteristic scaly integument, the generic name *Lepidomenia* was proposed for this species. (*Kow.*).

La Calle, Algeria on red coral; (*Marseilles?*).

Neomenia coralliophila Kow., Bull. Roy. Soc. Friends of Natural Science, etc., 1881, vol. 43, p. 5, pl. 1, 2 (Russian); Zool. Jahresbericht for 1882, p. 28 (abstract by Kowalevski).—*Lepidomenia coralliophila* Kow. & Marion, Contributions à l'histoire des Solénogastres ou Aplacophores, in Ann. Mus. Hist. Nat. Marseille, iii, p. 7, 1887.—*Echinomenia coralliophila* Simroth in Bronn, p. 233, pl. 10, f. 11–15.

The notes on the Marseilles specimen given above apparently apply to *L. hystrix*, subsequently defined. Simroth has restricted the name *Lepidomenia* to the latter species, although from the published record, the propriety of such a course is open to question.

Genus LEPIDOMENIA Kowalevski & Marion, 1887.

Lepidomenia Kowalevski, Zool. Jahresbericht für 1882, Mollusca, p. 29 (1883); referring to article on *Neomenia coralliophila* and *Cœloplana metschnikowii* in Bull. Soc. of Friends of Natural Science, etc., Moscow, xliii, 1881 (Russian).—*Lepidomenia* K. & M., Comptes Rend., ciii, p. 757; Ann. Mus. Marseille, iii, 1887,—Pruvot, Arch. Zool. Expér. et Génér. (2), ix, p. 730.—Simroth in Bronn, p. 233.

Body short, vermiform, tapering behind; cloacæ opening ventral. Foot groove passing into the cloaca posteriorly; foot flattened behind. Spicules part scale-like, part needle-shaped, part pyramidal, immobile; radula well developed, biserial. No gills.

The name *Lepidomenia* was first used by Kowalevski in 1881 or 1883 in connection with *Neomenia coralliophila* and a Marseilles form supposed to be specifically the same as *coralliophila*, but apparently identical with what was subsequently described as *L. hystrix*. Simroth has chosen to restrict *Lepidomenia* to the later described species, although the record would incline one to choose *N. coralliophila* as the type.

L. HYSTRIX Kowalevski & Marion. Pl. 48, figs. 99, 1–4.

Body yellowish; length a little over 2 mill.; section circular, tapering toward the posterior end; apparently covered with scales, but they are hyaline spicules, broad, and in juxtaposition at the base, with long projecting points (fig. 4). Salivary glands voluminous; radula biserial. A caudal sense-pit, surrounded by finer spicules.

Gulf of Marseilles, in calyx of the coral *Balanophylla italica*, in 30 fms.

Lepidomenia hystrix K. & M., Organisation du Lepidomenia hystrix, nouveau type de Solenogastre, Comptes Rendus, ciii, pp. 757–759 (1887). See also Q. Journ. Roy. Micros. Soc., 1887, p. 218; Ann. Mus. d'Hist. Nat. Marseille, iii, p. 7–25, pl. 1, 2.—PRUVOT, *l. c.*, p. 730.—SIMROTH, *l. c.*, p. 233, pl. 10, f. 1–10.

The "second specimen" from Marseilles commented on in the description of *Echinomenia coralliophila* seems to be *L. hystrix*, so far as I can see from the decidedly confused literature.

ADDENDA.

DENTALIUM ATRAMENTUM Schlüter, Kurzgefasstes Systematisches Verzeichniss meiner Conchylien-Sammlung, 1838, p. 39. Name only; fossil.

DENTALIUM MINIMUM Eth. & Bell, Trans. Roy. Geol. Soc. Cornwall, 1897, XII, p. 156 (1898).

Pliocene; St. Erth, Cornwall.

The name is preoccupied; but as this is probably not a valid species, it need not be renamed.

DENTALIUM GRANOSUM Eichw. (p. 230). This Lower Silurian species is probably to be removed from the Scaphopoda. Koken writes: the structure of these tubes is wholly diverse from that of a

Dentalium (Bull. l'Acad. Imp. Sci., St. Pétersb. [5], vii, 1897, p. 214).

DENTALIUM ALTERNANS Müll. (p. 224) is probably the same as *D. alternans* Ryck. (p. 220). See Holzapfel, Palæontographica, xxxiv, p. 178. As the name is preoccupied, *D. confusum* S. & P. will replace it, *D. muellerianum* becoming a synonym.

CADULUS OBRUTUS Conrad (p. 238). Add reference: *Gadus obrutus* Conr., Amer. Journ. Conch., V, p. 227.

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[NOTE.—The names of genera are printed in Roman type; of groups higher in rank in SMALL CAPITALS; of synonyms in *Italic*.]

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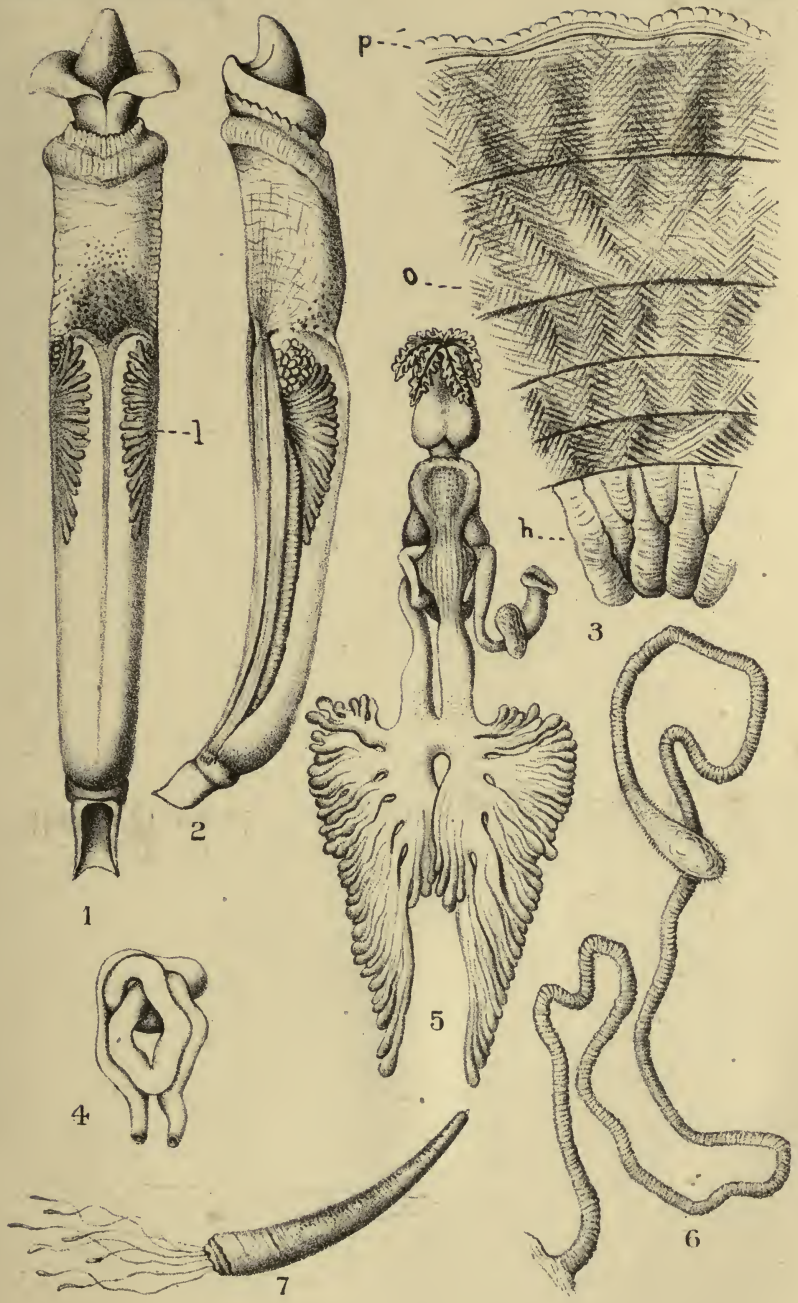
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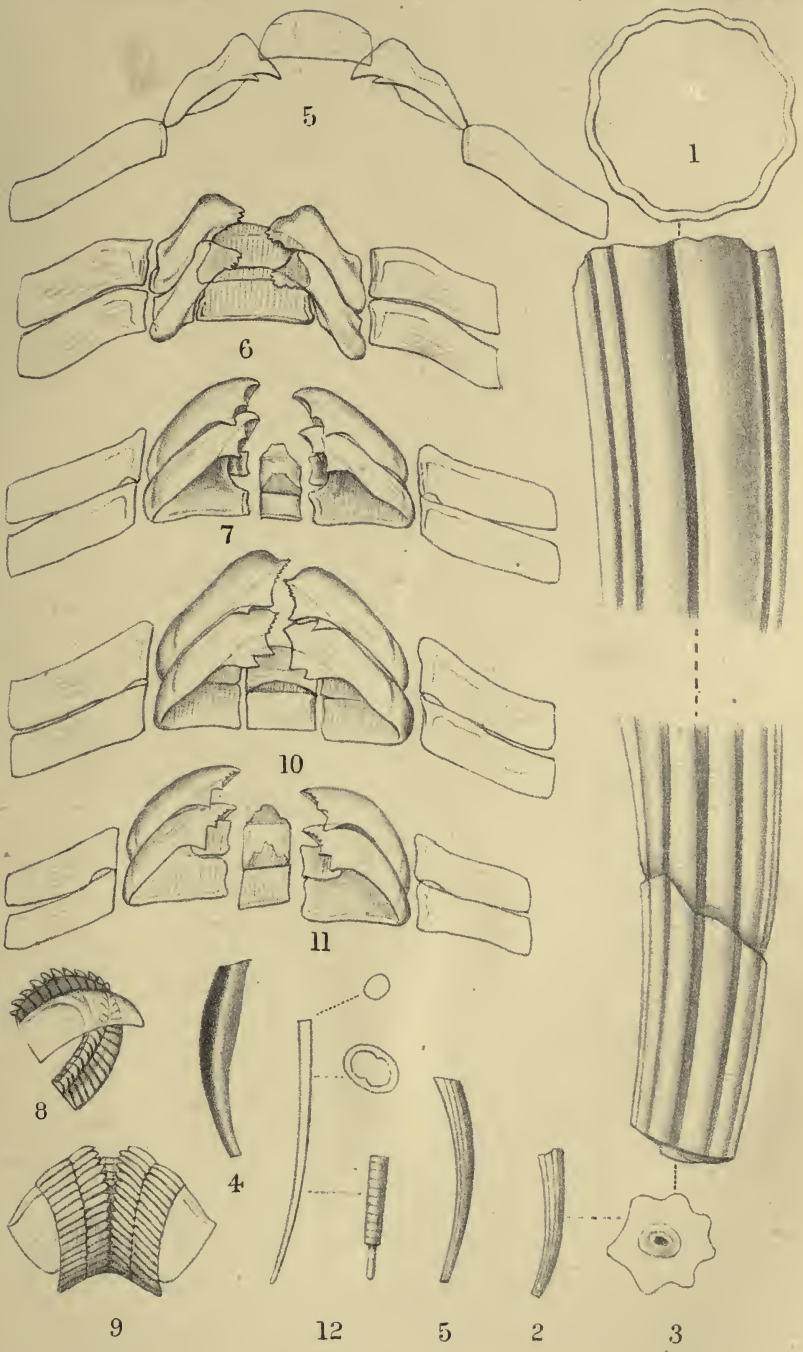
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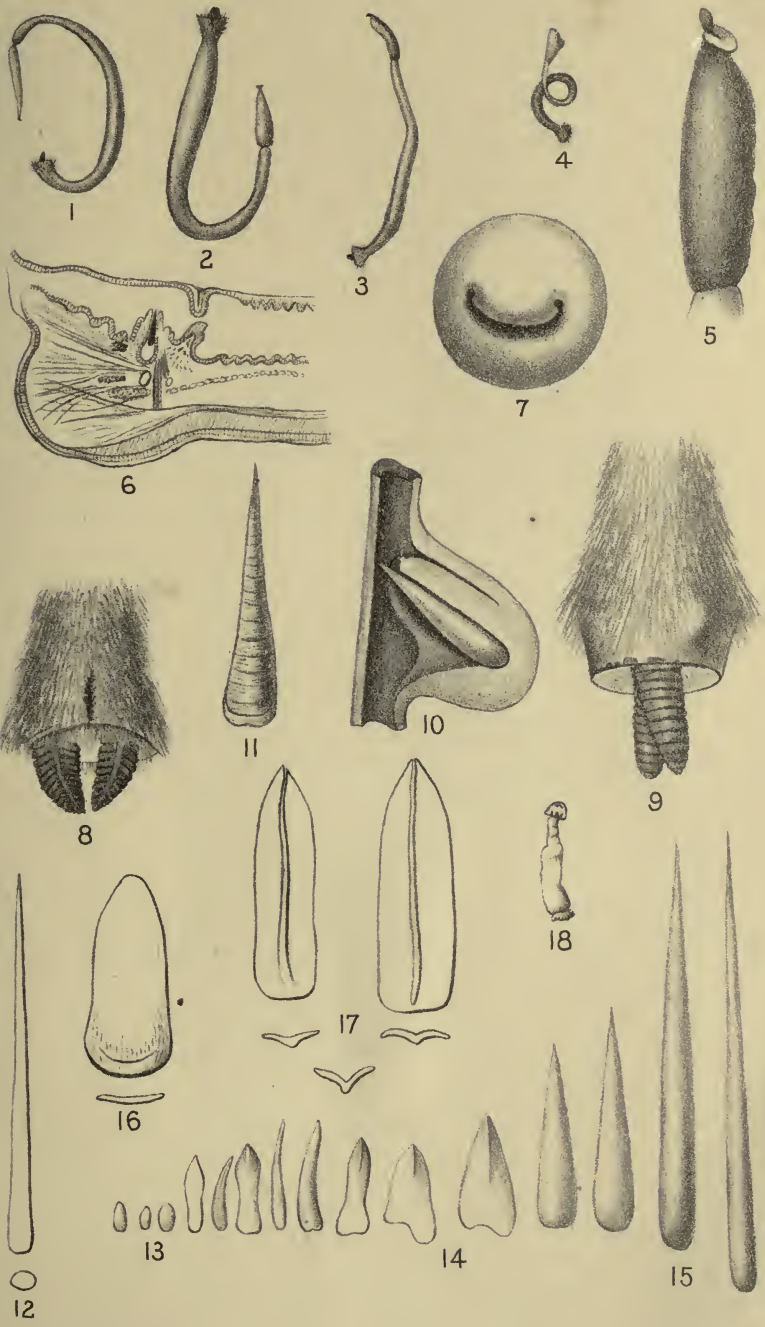
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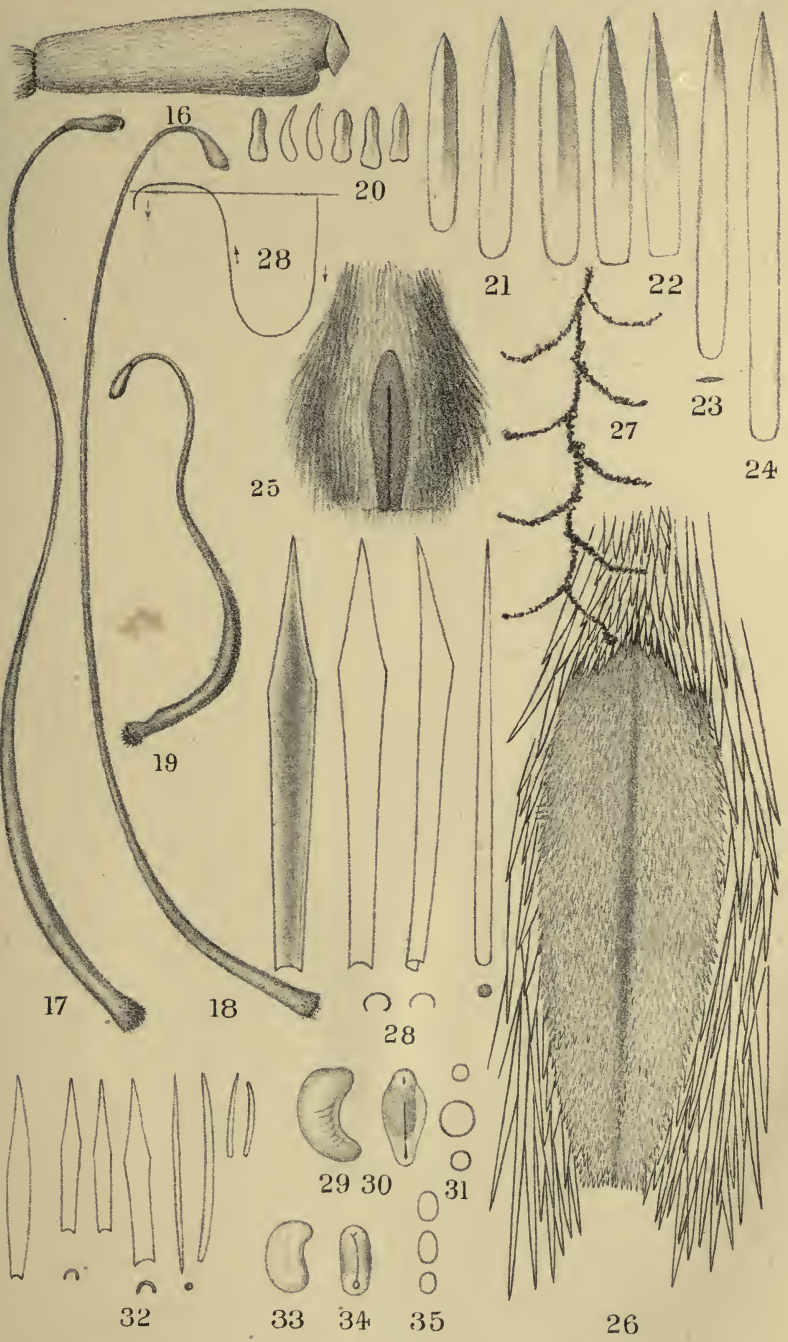
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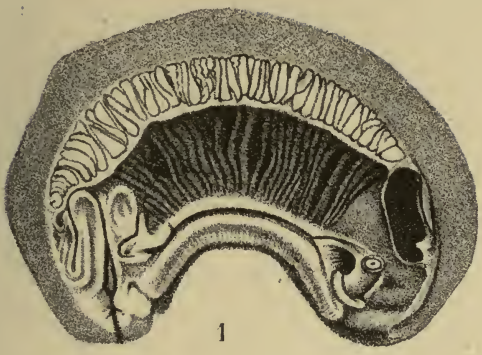

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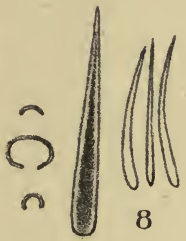

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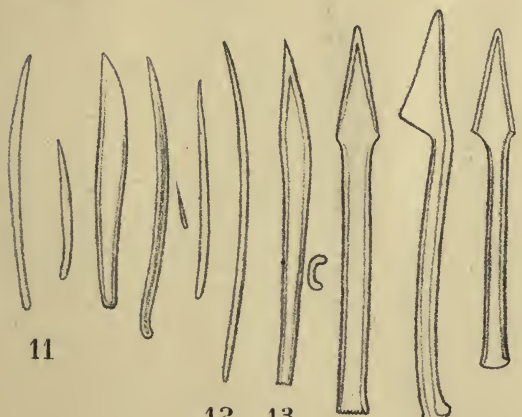

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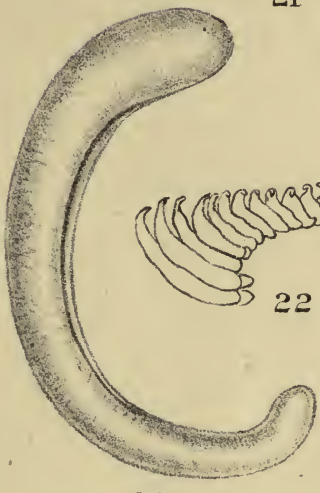

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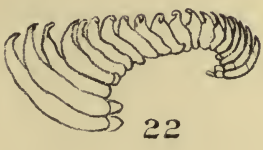

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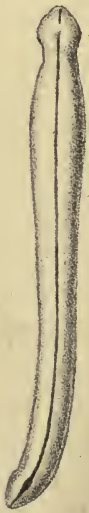

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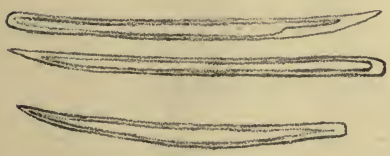

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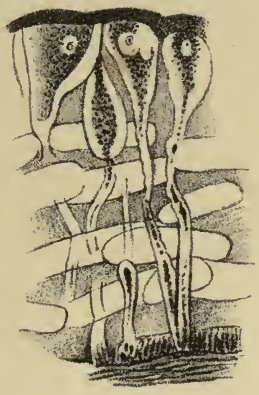

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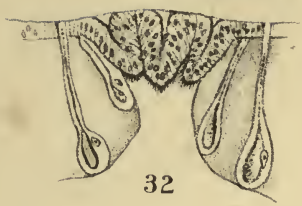

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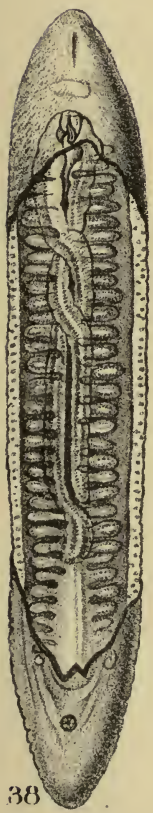

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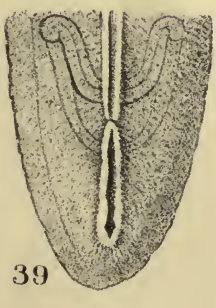

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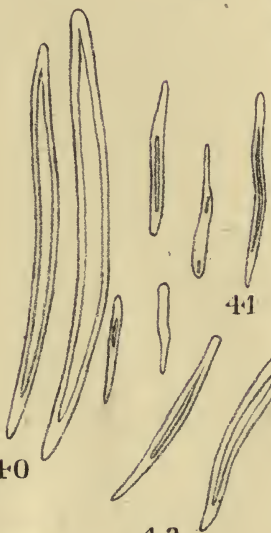

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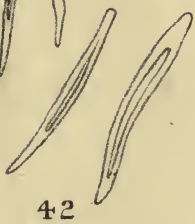

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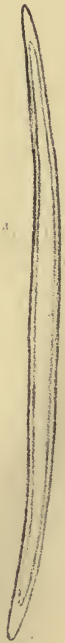

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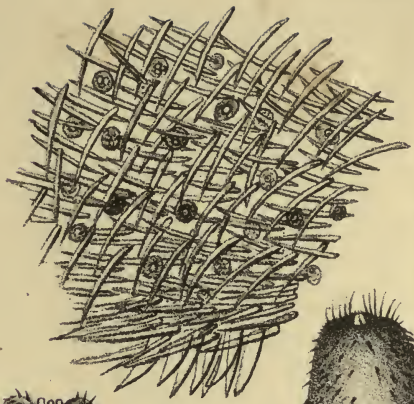

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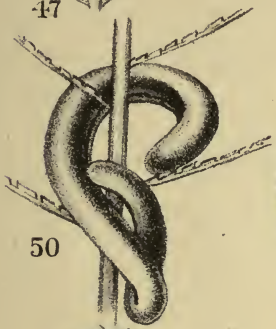

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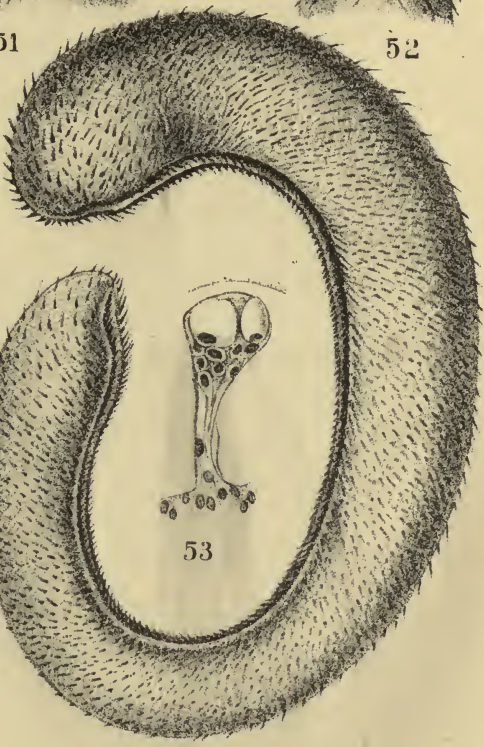

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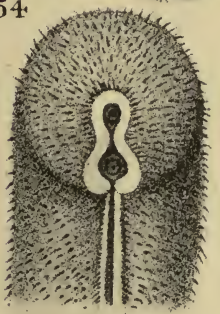

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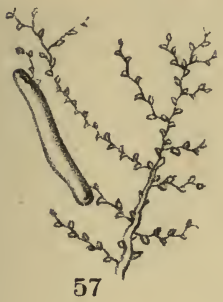
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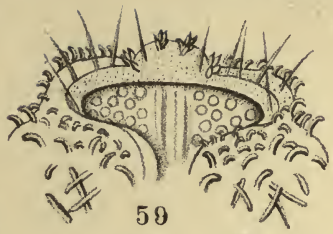
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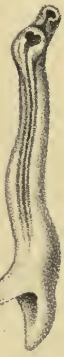
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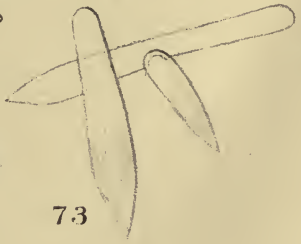
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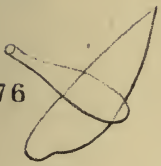
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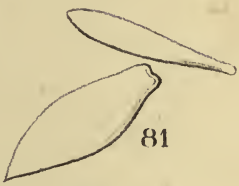
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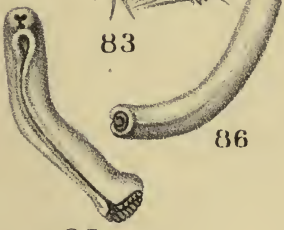
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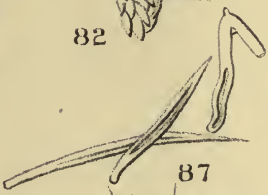
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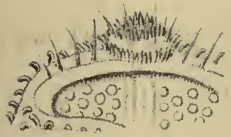
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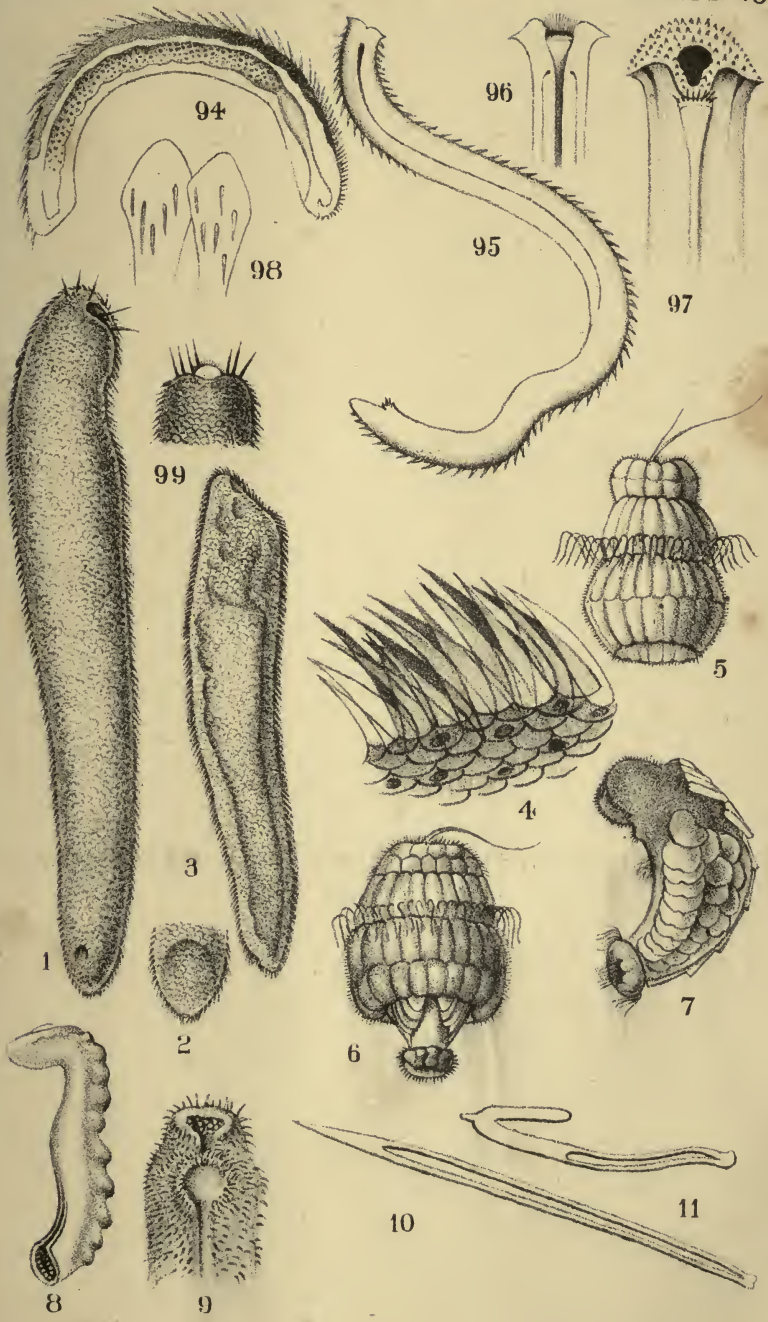
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